

NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT PERTH-ANDOVER TO WOODSTOCK

Final Comprehensive Study Report Volume 1 of 2



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**FINAL COMPREHENSIVE STUDY REPORT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK
NEW BRUNSWICK**





PROJECT NO. NBF14677

**FINAL COMPREHENSIVE STUDY REPORT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK
NEW BRUNSWICK**

**NEW BRUNSWICK DEPARTMENT OF TRANSPORTATION
PLANNING AND LAND MANAGEMENT BRANCH**

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EXECUTIVE SUMMARY

Introduction

Transport Canada (TC), Infrastructure Canada, and Fisheries and Oceans Canada (DFO), the federal Responsible Authorities (RAs) under the *Canadian Environmental Assessment Act (CEAA)*, delegated preparation of this Comprehensive Study Report (CSR) to the New Brunswick Department of Transportation (NBDOT) for the proposed development of a four-lane Trans-Canada Highway (TCH) from Perth-Andover to Woodstock.

The purpose of the CSR is to assess potential environmental effects of the proposed Project, and to identify methods of optimizing positive environmental effects and reducing adverse environmental effects that may result from the Project. The scope of the assessment includes the construction, operation, and maintenance of the proposed TCH (including interchanges and new connector roads); grade separations; secondary road modifications; stream crossings (e.g., bridges and culverts); severed property access roads between Perth Andover and Woodstock; accidents, malfunctions and unplanned events.

Project Alternatives

The objective of the Project was to upgrade the Trans-Canada Highway for the purposes of fostering economic development through improved capacity and to enhance motorist safety.

Prior to consideration of highway alignment alternatives, NBDOT considered other possible ways to satisfy travel and freight transportation demands and to improve the traffic safety along the TCH between Perth-Andover and Woodstock. Three alternatives to the Project were considered:

- the Null Alternative (do nothing scenario);
- upgrading of the highway capacity along the existing route (i.e., widening or twinning the existing TCH); and
- other modes of transportation (e.g., rail).

These alternatives to the Project all failed to achieve the objectives of the Project. The Null Alternative did not foster economic development in the region and did not enhance motorist safety. Widening the existing TCH was rejected for reasons such as higher accident rates, poor levels of service, and limited space due to the extent of commercial and residential properties. Twinning the existing TCH was rejected primarily due to space limitations making this option not technically feasible. Other modes of transportation were rejected because they did not achieve the goal of improving the Trans-Canada



Highway through New Brunswick, they would not foster economic growth in that region, and because of high capital and operating costs.

NBDOT produced three successive alignment alternatives between 1997 and 1999 that, through an iterative process of consultations with the public and input from regulatory agencies, resulted in a fourth alternative, the preferred alignment in 2003. This iterative process included refinements to avoid or minimize potential environmental, social—cultural and economic effects.

Project Description

The Project consists of the construction, operation, and maintenance of a new four-lane divided controlled access highway, approximately 70.7 km in length, that will by-pass the existing two-lane TCH, including interchanges and watercourse crossings and structures, and required ancillary work/facilities (e.g., new road connections, property access roads, and borrow and disposal areas). This new section of the TCH will be located in western New Brunswick, and will extend north/south between the Village of Perth-Andover and the Town of Woodstock. The proposed TCH alignment is located west of the existing TCH, between the Saint John River and the United States border. As such, the proposed TCH will not require/include new major bridge structures to cross the Saint John River.

The Project will require the construction of four bridge crossings along the proposed TCH and there will be 43 minor watercourse crossings that do not require bridge crossings. The Project will require the construction of 18 property access roads and 4 interchanges. There will be no rest areas constructed for the proposed Project.

The proposed TCH will be designed and constructed to RAD 120 (Rural Arterial Divided highway with design speed of 120 kph) Transportation Association of Canada (TAC) Standards, allowing the planned posted speed of 110 kph.

NBDOT plans to complete construction of the Project in four years beginning in 2004 and ending at the conclusion of the 2007 construction season. To date the Project has undergone the functional planning process to select an alignment. NBDOT preliminary pre-design construction costs of the Project are estimated at \$200 million.

Environmental Effects Assessment Methodology and Scoping

The methodological approach employed in this Comprehensive Study provides an evaluation of Project-related environmental effects and is designed to address the scope of the Project and the factors to be considered as outlined in Sections 15 and 16 of *CEAA* and as determined by the responsible authorities in their scope determination (Guidelines; Appendix A) thereunder.



The environmental assessment method followed a six step process to arrive at a determination of significance for Project-related environmental effects. These are:

- identify the issues through scoping and select Valued Environmental Components ("VECs") on which to focus the environmental assessment;
- establish boundaries for the environmental assessment and residual environmental effects rating criteria ("thresholds of significance") for determining the significance of environmental effects for each VEC;
- identify environmental effects of Project activities, by Project phase and also the changes to the Project caused by the environment;
- evaluate environmental effects using the significance criteria identified in Canadian Environmental Assessment Agency guidance documentation (CEAA 1994) in light of proposed mitigation;
- analyze the environmental effects and predict their significance by applying the residual environmental effects rating criteria; and
- outline a monitoring and follow-up program, as required.

Public consultation was conducted with identified stakeholders, the general public and the Aboriginal community to identify additional issues for inclusion in the CSR. Consultation took place over six years (1998-2004), and includes a First Nation Traditional Ecological Knowledge Study.

Over the course of the public consultation process a number of common issues, questions and concerns were raised regarding private water supplies, increased noise levels, loss of quality of life, property access, access roads, loss of livelihood due to property severance and loss of revenue due to by-pass of businesses.

All issues raised during public consultation were reviewed and evaluated for their relevance to the Comprehensive Study, and considered during the scoping process and selection of the VECs.

Environmental Effects Assessment

Project-VEC interactions were analyzed to determine potential environmental effects associated with Project components and activities. The analysis for each VEC was carried out for each Project phase and potential accidental and/or unplanned events including fires, hazardous spills, erosion and sedimentation control failure, bridge or culvert washout, vehicular collisions, wildlife encounters, changes in land use, disturbance of archaeological or heritage resources, and changes in commercial activity. The analysis used qualitative and, where possible, quantitative information available from existing knowledge (including baseline studies) and appropriate tools, as well as considering identified measures.



Residual environmental effects were predicted for VECs following the application of proposed mitigation measures. The residual environmental effects of each Project phase were evaluated as either significant (S), not significant (NS), or positive (P), based on the significance threshold developed for each VEC. The significance of residual environmental effects, as determined for each VEC are summarized in Table 1.

Table 1 Summary of Residual Environmental Effects of the Project

VEC	Construction	Operation	Maintenance	Accidents, Malfunctions and Unplanned Events	Project Overall
Atmospheric Environment	NS	NS	NS	NS	NS
Groundwater Resources	NS	NS	NS	S*	NS
Surface Water Resources	NS	NS	NS	S*	NS
Fish and Fish Habitat	NS	NS	NS	S*	NS
Vegetation**	NS	NS	NS	NS	NS
Wetlands	NS	NS	NS	NS	NS
Wildlife	NS	NS	NS	NS	NS
Land Use	NS	NS	NS	NS	NS
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons	NS	NS	NS	S*	NS
Archaeological and Heritage resources	NS	N/A	N/A	NS	NS
Labour and Economy	NS	NS	NS	NS	NS
* low likelihood of occurrence					
** includes Appalachian Hardwood Forest and rare plants					

In all cases, the residual environmental effects of the Project were determined to be not significant (NS) except for in the case of accidental or unplanned events (*i.e.*, hazardous materials spills) occurring with respect to groundwater, surface water and fish and fish habitat. These effects would result in a possible significant (S) effect on the surrounding environment, however, in those cases the likelihood of occurrence is very low, and would be further reduced by development of the Project (*e.g.*, less chance of head on collision because of divided highway lanes).

Effects of the environment on the Project include those from weather-related events (*e.g.*, precipitation and erosion), seismic-related events (*e.g.*, earthquakes and rock slides), and forest fires. The Project will be planned, designed and constructed such that the identified effects of the environment on the Project were determined to be not significant, or if significant, extremely unlikely (*i.e.*, large-scale seismic event).



Compensation Measures

Compensation measures are an essential part of the mitigative strategy for minimizing the potential residual environmental effects of the Project. NBDOT will be responsible for providing compensation for fish habitat, wetland habitat, and property loss.

NBDOT will establish a habitat compensation bank in advance of ground breaking construction activities, to address the issue of habitat compensation required for full HADD authorization under the *Fisheries Act*, and will manage the compensation bank throughout the duration of construction and follow-up monitoring. The purpose of fish habitat compensation is to achieve a net gain in fish habitat productivity to offset Project-related harmful alteration, disturbance or destruction of fish habitat.

The potential loss of rare plants and AHF was minimized during the alignment selection process. Residual rare plants and AHF loss will be compensated through the acquisition and protection of high quality AHF near the RoW. In addition, rare plants will be avoided during design and construction of watercourse structures (e.g., Big Presque Isle River Bridge). The loss of butternut within the RoW will be compensated for through the collection and preservation of genetic information from affected trees.

A wetland compensation plan will be developed in consultation with NBDNR and Environment Canada's Canadian Wildlife Service, in accordance with Federal Wetland Policy and Provincial Wetland Policy, will ensure that there is no net loss of wetland area.

Owners of property within the RoW will be compensated through land acquisition. Properties that are severed in such a manner that a remnant parcel precludes current land use (e.g., agriculture) will be mitigated through provision of compensation and or alternate access.

Cumulative Environmental Effects Assessment

Under CEAA, a Comprehensive Study is required to consider the cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out.

The assessment of cumulative environmental effects of the proposed Project considered the following categories of past, present and future projects and activities that will be carried out:

- Existing Highways and Roads;
- Current and Future TCH Projects;
- Planned Development along Proposed TCH;



- Adjacent Land Uses; and
- Other Planned Development

The VECs and indicators considered in the cumulative environmental effects assessment are listed in Table 2.

Table 2 VECs and Indicators for Cumulative Environmental Effects Assessment

Valued Environmental Component	Indicator(s)
Fish Habitat and Water Quality	Sedimentation
Atlantic Salmon	Upper Saint John River Atlantic Salmon Returns
Appalachian Hardwood Forest	Loss of AHF Habitat
Wetlands	Loss of Wetland Area
Moose and Moose Habitat	Moose Population
Migratory Birds of Special Conservation Concern	Mature Forest Migratory Bird Habitat Loss and Fragmentation
Agricultural Land	Agricultural Land Area

The Project is not anticipated to result in substantive contributions to cumulative environmental effects due to the extensive mitigation measures and rigorous environmental management plan of the Project, and because of fish habitat, wetland habitat, AHF, rare plants, and land owner compensation measures required as a result of the Project.

Monitoring and Follow-up

A preliminary Follow-up Program, designed in consultation with the Responsible Authorities (RAs) and the New Brunswick Department of Environment and Local Government (NBDELG), is outlined in the CSR, and will be finalized and approved prior to implementation. An annual Follow-up Program report will be produced and provided to appropriate regulators for as long as follow-up activities are required. In addition, all environmental-related monitoring results (e.g., pH of watercourses identified as potentially affected by sulfide bearing rock) will be provided to RAs, NBDELG, and Environment Canada at quarterly intervals, or as results become available.

The proposed monitoring and follow-up activities includes the following key activities.

- Noise monitoring, where warranted, to address any complaints from residents living near the highway, which will be conducted at specific noise sensitive areas, in accordance with methods acceptable to NBDELG.
- Groundwater monitoring program for drilled wells within 500 m of blasting activity to establish baseline conditions prior to and during construction.
- Groundwater monitoring program for dug wells located within 50 m of a major over burden cut.



- Surface water and fish and fish habitat compliance and effectiveness monitoring program.
- A follow-up monitoring plan will ensure that the created fish habitat for habitat compensation is functioning as planned.
- Compliance monitoring (*i.e.*, regular inspections of culverts and bridges to ensure their effectiveness as mitigation).
- Monitoring in areas for potential environmental effects of salt spray is recommended.
- Wetlands within the Assessment Area will be monitored, within a short period after construction is completed, to visually assess wetland hydrology, introduction of invasive plant species, and use by recreational vehicles.
- Monitoring of moose and deer in the vicinity of the proposed TCH is recommended. A follow-up aerial survey involving NBDNR personnel is recommended over the next winter to fine tune and confirm the high use areas that may warrant wildlife fencing, among other mitigation.
- NBDOT will work with the Carleton-Victoria Forest Products Marketing Board to encourage the management of regenerating forest habitat near the Project footprint.
- Archaeological monitoring, by a qualified archaeologist, during initial ground breaking activities at the Lower Guisguet River and the Little Presque Isle River (Hartland Interchange connector road) crossings.





GLOSSARY

Abbreviations

dB_A – decibels on the A-weighted scale (measure of noise)
ha – hectare
km – kilometre
kPa – kilopascals (measure of pressure)
kph – kilometres per hour
m – metre

Acronyms

ACCDC – Atlantic Canada Conservation Data Centre

AAC - Annual Allowable Cut

ARWIS – Advanced Roadway Weather Information System

ASU – Archaeological Services Unit

ATV – all terrain vehicle

BMP - Best Management Practice

CEA Agency – Canadian Environmental Assessment Agency

CEAA – Canadian Environmental Assessment Act

CCS - Census Consolidated Subdivisions

CLI – Canada Land Inventory

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

CRDC - Carleton Regional Development Commission

CSIF – Canadian Strategic Infrastructure Fund

CSR – comprehensive study report, as defined in *CEAA*



CVFPMB – Carleton-Victoria Forests Products Marketing Board

CWS – Canadian Wildlife Service

DAFA - Department of Fisheries and Aquaculture

DFO - Department of Fisheries and Oceans Canada

CEPA – Canadian Environmental Protection Act

CCME – Canadian Council of Ministers of the Environment

EA – environmental assessment

EFG – environmental field guide

EIA – environmental impact assessment

EIS – environmental impact statement

EPP – environmental protection plan

GCSI - Global Change Strategies International Inc.

GDP - Gross Domestic Product

HADD – harmful alteration, disruption or destruction (of fish habitat)

MAR - mean annual runoff

MAP - mean annual precipitation

MBCA – Migratory Birds Convention Act

MSC – Meteorological Service of Canada

LOS - level of service

NBDELG (formerly NBDOE) – New Brunswick Department of Environment and Local Government



NBDNR (formerly NBDNRE) – New Brunswick Department of Natural Resources (formerly and Energy

NBFSC - New Brunswick Federation of Snowmobile Clubs

NBDOT – New Brunswick Department of Transportation

NSA – noise sensitive area

NTNB – Nature Trust of New Brunswick

NWPA – *Navigable Waters Protection Act*

Parclo - Partial Clover interchange.

PID – property identification number

POL – Petroleum, Oil, or Lubricant

RA – Responsible Authority, as defined in *CEAA*

RAD 120 – Rural Arterial Divided highway with design speed of 120 kph

RCU 80 – Rural Collector Undivided highway with design speed of 80 kph

RoW – right of way

SARA – Species at Risk Act

TAC – Transportation Association of Canada

TC – Transport Canada

TCH – Trans-Canada Highway

TRC – Technical Review Committee

US – United States



VEC – Valued Environmental Component

WHMIS – Workplace Hazardous Material Information System

Terms

access road:	a road that provides a route for landowners to get to land where the previous route to the land has been eliminated as a result of the highway
alignment:	refers to the highway route in general, but does not specifically mean the actual area to be affected by construction
berm:	a small dyke intended to slow the flow of run-off water to allow heavy sediment material to drop out
borrow pit:	a source for gravel, sand and/or rock materials to be used in construction, the source of which is located outside the RoW
bridge	any structure in excess of 3 m in span length carrying vehicular and/or pedestrian traffic
centreline:	the line defined as being the centre of the proposed lane, either the westbound or eastbound lane
chainages	distance along the alignment in kilometres from northern most limits of Project
check dam:	an erosion control structure constructed of hay bales, timber or loose rock to control water flow in an erodible channel or ditch.
clover interchange:	an access onto and off of the highway that from an aerial view resembles a four-leaf clover.
cofferdam:	a temporary structure constructed around an excavation to exclude water so that work in or adjacent to a watercourse can be carried out in the dry.
consolidation:	the act of amalgamating two or more parcels of land into one larger parcel of land.
culvert:	any structure not classified as a bridge, and/or drainage system, which provides an opening for the passage of water under any roadway or driveway.



current TCH:	refers to the existing two-lane Trans-Canada highway
diamond interchange:	an access onto and off of the highway that from an aerial presents a four-sided diamond shape.
ditch:	a small artificial channel excavated through the earth's surface for drainage, irrigation or to bury pipes, wires or cables or for various other purposes.
downstream:	in the direction of the normal flow of a watercourse.
e.g.:	an abbreviation meaning "for example"
electrofishing:	a method of capturing fish in a freshwater body by the use of a device that emits a low voltage shock that temporarily stuns the fish
erosion:	the process of soil and rock weathering caused by natural means (<i>i.e.</i> , gravity, water, wind, ice).
existing TCH:	the existing Trans-Canada Highway, Route 2, through New Brunswick.
fish habitat:	the spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes
footprint:	the area to be affected by the activities associated with the construction of the Project.
grading:	the act of altering the ground surface to a desired grade or contour by cutting, filling, levelling, and/or smoothing.
grubbing:	the removal of roots and stumps after clearing, leaving topsoil to be salvaged.
highway:	the whole strip of land reserved for and secured for the use of the travelling public.
hydroseed:	a mixture of various grass seeds, fertilizer and water with a binding agent typically used as an erosion control methodology. This mixture, when spread on the ground grows grass very quickly relative to the planting of seeds and can be spread over large areas of ground mechanically.
<i>i.e.</i> :	an abbreviation meaning "that is"



- migratory birds: birds protected in Canada under the *Migratory Birds Convention Act*, as listed in the Canadian Wildlife Service Occasional Paper No. 1, 1991 edition.
- mitigation: actions to avoid or compensate for the environmental effects resulting from the proposed project activity.
- (partial clover interchange): an interchange that only provides access to one side of a four-lane highway and from an area view resembles a one-leafed clover
- passerine birds: birds of the order *Passeriformes* that includes over half of all living birds and consists chiefly of perching songbirds
- Project: the construction, operation, and maintenance of a new four-lane divided controlled access highway, approximately 70.7 km in length, that will by-pass the existing two-lane TCH between Perth-Andover and Woodstock, including interchanges and watercourse crossings and structures, and any required ancillary work/facilities such as new road connections, property access roads, and borrow and disposal areas.
- proposed TCH: refers to the proposed new four-lane highway, which if approved and completed will be referred to as the Trans-Canada Highway
- remnant: typically a relatively small piece of land that is cut off from a larger piece of land by the highway RoW.
- right of way (RoW): the land secured and reserved to the public for Highway purposes.
- riparian: the area adjacent to flowing water that contains elements of both aquatic and terrestrial ecosystems.
- salmonid: of or related to the salmonidae family of fish, including trout, salmon and char.
- severance: the act of cutting off a piece of land from a larger parcel of land
- severed: a piece of land that has been cut off from a larger parcel of land
- silvicultural: the practice of managing a section of forest (through such activities as thinning) in order to increase the growth of trees in the area



- stakeholder: A member of a group or an individual who has a vested interest in the Project, beyond just owning land on the RoW. Typically an economic interest.
- substrate: mineral and organic material that forms the bed of a stream.
- Trans-Canada Highway: refers to the New Brunswick portion of the continuous highway that crosses the entire country of Canada.
- watercourse: the full width and length, including the bed, banks, sides and shoreline, or any part of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow be continuous or not.
- wetland: lands transitional between terrestrial and aquatic systems where the water table is at or near the surface or the land is covered by shallow water at some time during the growing season. Wetlands are characterized by poorly drained soils and predominantly hydrophytic or water tolerant vegetation.





1.0 INTRODUCTION

This report is a Comprehensive Study Report (CSR) for the development of a four-lane Trans-Canada Highway (TCH) between Perth-Andover and Woodstock, New Brunswick (the "Project"). Transport Canada (TC), Infrastructure Canada, and Fisheries and Oceans Canada (DFO), the federal Responsible Authorities (RAs) under the *Canadian Environmental Assessment Act (CEAA)*, delegated preparation of this CSR to the New Brunswick Department of Transportation (NBDOT), the Proponent as per Section 17 of *CEAA*. Jacques Whitford Environment Limited, with the assistance of ADI Limited, AGFOR Inc., and Hydro-com Technologies Limited, have undertaken preparation of this CSR on behalf of NBDOT. As well, the report provides responses to issues raised by reviewers of the Project registration under the New Brunswick Environmental Impact Assessment (EIA) process *Clean Environment Act—Environmental Impact Assessment Regulation (87-83)*.

1.1 Project Overview

The existing TCH (Route 2) through New Brunswick is 519 km in length from Quebec to Nova Scotia. Approximately 130 km (or 25%) of the existing TCH remains to be upgraded to a four-lane, divided, controlled access highway. On August 14, 2002, the federal and provincial governments committed to the completion of the remaining section. Completion of the TCH upgrading will occur in various segments.

The Project involves construction and operation of a 70.7 kilometre (km) fully controlled access, four-lane divided highway from Perth-Andover to Woodstock. The proposed TCH will by-pass the existing two-lane facility and will become the new TCH (Route 2), with a travel distance of approximately 5.5 km less than the existing TCH. The proposed TCH alignment begins just south of the existing TCH/Route 190 Interchange in the Village of Perth-Andover, continues past Florenceville and Hartland, and terminates near the existing TCH/Route 550 (Connell Road) intersection in the Town of Woodstock.

1.2 Purpose and Need for the Project

The purpose of the Project is to address traffic and safety concerns associated with uncontrolled highway access, and increasing level of through traffic and truck traffic on the existing two-lane TCH. The Project will be a Level I access controlled highway with a design standard of RAD 120 (Rural Arterial Divided Highway with design speed of 120 kph). Twinning of the existing TCH to current controlled access standards is not feasible primarily due to the extent and proximity of existing land use and the associated potential environmental effects on that land use. In addition to being divided and four-lane, the proposed TCH will improve highway safety by segregating through traffic from the local traffic that would continue to use the existing two-lane TCH. Wildlife management along the corridor will also be improved. The completion of the proposed TCH section will bring this segment up to the required standards that are consistent with the remainder of the TCH from the Nova Scotia border to Longs Creek. Motorists will



still have the option to travel the scenic, local route through to Woodstock, Pokiok and ultimately Fredericton without having to travel the proposed TCH.

1.3 Regulatory Framework

The Project is subject to an Environmental Assessment (EA) under *CEAA* (comprehensive study) and is also subject to registration under the New Brunswick EIA process. Transport Canada is an RA for the Project under *CEAA* by virtue of federal funding (50%) being provided for the Project through the Canadian Strategic Infrastructure Fund (CSIF), administered by Infrastructure Canada. DFO is also an RA for the Project due to the requirement for approvals pursuant to section 5 (1) of the *Navigable Waters Protection Act* and section 35 (2) of the *Fisheries Act*, both of which are included in the *Law List Regulations* under *CEAA*. A CSR is required for the Project as it involves construction of an all-season public highway greater than 50 km in length and which is proposed to be located on a new RoW (RoW). The Project is not on the *Exclusion List Regulations*. The Project has not been referred directly to a mediation or panel review.

The Province of New Brunswick conducts environmental assessment of selected projects under the *Clean Environment Act—Environmental Impact Assessment Regulation* (87-83). Under this regulation, all major highway projects involving either a significant length of new highway alignment or a major upgrading or widening of an existing highway resulting in a change in its intended use or classification are undertakings requiring registration. The Project was registered in February 2002, and the reviewers (including federal departments) through the New Brunswick Department of Environment and Local Government (NBDELG) have identified the issues they require to be addressed in the CSR. These issues have been captured in the *Guidelines for the preparation of a Comprehensive Study Report – Perth-Andover to Woodstock Twinning of Route 2 – Trans-Canada Highway, New Brunswick* (Appendix A) and are addressed in this report.

Project activities will be conducted in accordance with federal and provincial Acts and applicable regulations, including, but not limited to:

- *Canadian Environmental Assessment Act;*
- *Fisheries Act;*
- *Navigable Waters Protection Act (NWPA);*
- *Canadian Environmental Protection Act (CEPA);*
- *Migratory Birds Convention Act;*
- *Canada Water Act;*
- *Canada Wildlife Act;*
- *Species at Risk Act (SARA);*
- *New Brunswick Highway Corporation Act;*



- New Brunswick *Clean Environment Act*;
- New Brunswick *Clean Water Act*;
- New Brunswick *Fish and Wildlife Act*; and
- New Brunswick *Endangered Species Act*.

In addition to regulatory requirements, the Project will also be subject to the numerous applicable federal and provincial guidelines. The specific relevance of these regulations, policies and guidelines to the Project is discussed throughout this report.

1.4 Organization of the Report

The CSR is organized to reflect the process by which the assessment has been conducted. It is organized into 7 major sections. A summary of the CSR Report including conclusions from the EA is presented at the beginning of the report, in the Executive Summary.

Section 1.0 provides background information on the Project including the purpose and need for the Project and the regulatory framework.

Section 2.0 provides a description and discussion of Project Alternatives including alternatives to the Project and alternate means of carrying out the Project.

Section 3.0 provides a detailed description of the Project. Construction activities are discussed as well as the location, scope and schedule for the Project.

Section 4.0 provides a description of the issues scoping exercise, including a summary of public, stakeholder, Aboriginal, and regulatory consultation efforts. The environmental assessment methodology employed for this assessment is also described in Section 4.0.

Section 5.0 provides the results of the environmental effects assessment for biophysical and socioeconomic components, including potential environmental effects of malfunctions and accidental events. Included within each component section, where appropriate, is the framework for compliance and follow-up programs to be undertaken. Also included is a discussion of the effects of the environment on the Project.

Section 6.0 provides an assessment of potential cumulative environmental effects of the Project in conjunction with past, present and likely future projects within the zone of influence of the Project.



Section 7.0 offers concluding statements and recommendations.

Section 8.0 details literature and personal communications cited in the report. A series of technical reports, mapping and other supporting information is contained in the appendices to this document.



2.0 PROJECT ALTERNATIVES

As required under section 16 (2) (b) of *CEAA*, a consideration of project alternatives is required for all comprehensive study level environmental assessments. Project alternatives are considered during the environmental assessment to demonstrate that the proponent has considered other possibilities during the planning process and project design.

Two categories of project alternatives have been considered.

- Alternatives to the Project are defined as functionally different ways of achieving the same end (*CEAA* 1994). Alternatives to the Project include: the "do nothing" scenario (null alternative); upgrading the existing TCH (*i.e.*, widening the existing TCH); or other modes of transportation (*i.e.*, marine, rail, air).
- Alternative means of carrying out the Project include technically and economically feasible options that can reasonably meet the Project objectives. Alternative means of carrying out the Project include alternate routes that will maintain the design objectives of constructing four-lane divided controlled access highway from Perth-Andover to Woodstock, as part of NBDOT's initiative to provide a four-lane highway system from Quebec to Nova Scotia.

The proposed Project, as indicated in Section 1.0, consists of the construction and operation of a 70.7 km fully controlled access, four-lane divided highway from Perth-Andover to Woodstock. The proposed Project will by-pass the existing two-lane facility and will become the new TCH.

2.1 Alternatives to the Project

Since the 1980's the Province has maintained an objective to upgrade the TCH through New Brunswick to foster economic development through improved capacity and enhance motorist safety (NBDOT 1989). Currently, much of the TCH in New Brunswick has been constructed to a four-lane divided standard. The objective of this proposed Project is to contribute to the Province's overall objective to upgrade the TCH.

Prior to consideration of routing alternatives, NBDOT considered other possible ways to satisfy travel and freight transportation demands and to improve the traffic safety along the TCH between Perth-Andover and Woodstock. Three alternatives to the Project were considered:

- the Null Alternative (do nothing scenario);
- upgrading of the highway capacity along the existing route (*i.e.*, widening the existing TCH); and
- other modes of transportation (*e.g.*, rail).

As defined below, these alternatives to the Project failed to achieve the Project objective and were subsequently dispelled as non-viable alternatives.



2.1.1 Null Alternative

The null alternative involves the continued operation and maintenance of the existing two-lane TCH, as it is at present. This alternative is the low cost alternative, as it would not involve new construction, or affect new lands or socio-economic activities. The null alternative, however, would be contradictory to the long-standing objective of NBDOT to upgrade the National Highway System network through New Brunswick.

According to current NBDOT plans, if this segment of the TCH from Perth-Andover to Woodstock is not upgraded to four-lane divided RAD 120 standards, it would be the only segment of the TCH in the Province that does not meet this standard after 2007 with the exception of the Pokiok to Longs Creek segment and the Grand Falls to Aroostook segment, which are presently at various stages of the regulatory approvals process. In fact, it would be the only segment of the TCH that a traveler would encounter between Halifax, Nova Scotia and the New Brunswick/Quebec border not constructed to this standard.

The existing two-lane TCH consists of a winding alignment with steep grades and few passing opportunities. Operating conditions include heavy truck traffic and vehicles entering and exiting directly into the traffic stream from local roads and private driveways. Infrequent passing opportunities along this two-lane segment of the TCH often leads to the accumulation of traffic into platoons that flow at less than posted speeds. This has resulted in risky passing manoeuvres by frustrated motorists.

The rate of fatal accidents along the existing TCH from Perth-Andover to Woodstock as seen in Table 2.1.1, is more than four times higher than would be expected with the proposed TCH standard.

Table 2.1.1 Accident by Severity, Perth-Andover to Woodstock

Highway Segment	Fatal Accident Rate (Acc./100MVK*)	Injury Accident Rate (Acc./100MVK*)	PDO Accident Rate** (Acc./100MVK*)
Existing Route 2 – Perth-Andover to Woodstock	1.37	14.10	32.22
Proposed TCH – Perth-Andover to Woodstock	0.30	9.94	24.86
* Accidents per 100 million vehicle kilometres ** Property Damage Only Source: NBDOT (2003).			

The null alternative would result in continued poor levels of service and higher accident rates. It would not satisfy the Provincial design and safety standards, or the economic objectives, set for the TCH and the National Highways System. Therefore, the "do nothing" alternative was not considered to be an acceptable alternative to the proposed Project by the Province as it does not meet the objectives of the Project to foster economic development and enhance motorist safety.



2.1.2 Upgrading Existing Alignment

The alternative to upgrade the existing TCH would involve improvements made along the existing TCH alignment. This would involve either the addition of a third lane to the existing TCH, or twinning the existing TCH.

2.1.2.1 Third Lane

This upgrade alternative is a way to increase highway capacity by adding a third lane to the existing two lanes, normally as climbing or left turning passing lanes. This provides passing opportunities on uphill grade sections and for left turn stopping at-grade intersections. Addition of a third lane can supplement the capacity of a two-lane highway at relatively low capital cost. The existing TCH presently has some sections that provide a third passing and/or turning lane.

It has been found that frequent use of the third lane approach in both directions can cause driver confusion. This has led to higher incidence of head-on collisions than would be experienced on a four-lane divided highway. This can be even more pronounced when entering a three-lane highway section from a four-lane divided highway, as would be the case if this alternative were applied to the Perth-Andover to Woodstock TCH segment.

This segment of the TCH between Perth-Andover and Woodstock consists of frequent at-grade highway accesses from private residential driveways, commercial roadside developments, farm and woodlot access, and local roads. NBDOT found that the marginal increase in highway capacity of a third lane would be insufficient to offset the additional safety risks. NBDOT did not consider this alternative along the existing TCH to be a viable upgrading option as it does not meet the Project objective of enhancing motorist safety.

2.1.2.2 Twinning

Twinning the existing TCH has been a consideration of NBDOT along all upgraded sections of the TCH throughout the Province. Twinning involves using and upgrading, if required, the existing two lanes of highway and constructing two new parallel lanes to achieve four-lane divided highway design standards.

All levels of service, capacity and safety objectives can be met with the twinning alternative. However, in order to attain full access control required to meet the Project objective, the highway twinning alternative would require that all existing at-grade access to the existing TCH be cut off. Access to the twinned highway would only be permitted at grade - separated interchanges. Twinning is a viable alternative in unpopulated areas, where there would be less property disruption or need for construction of property access roads. It would be very costly to twin the existing TCH between Perth-Andover and Woodstock,



as it is highly populated (*i.e.*, hundreds of homes and businesses) with frequent private driveways and property access roads.

As described in Section 3.0, short segments at each end of the proposed Project will be twinned. Other opportunities for twinning of the existing TCH along this segment are limited due to the extent of residential and commercial development. Furthermore, it is technically difficult and economically inefficient to design by-pass segments to avoid the populated areas that would connect to minor twinned segments that could be constructed along the unpopulated areas of the existing TCH.

Due to the extent of development along most of the existing TCH from Perth-Andover to Woodstock, there would be considerable incremental cost in providing an adjacent service road network. These service roads would sever valuable farmland properties and disrupt commercial and residential land uses and, in some instances, may not be technically feasible. Whereas with a by-pass route, as proposed, the existing two-lane TCH will continue to provide the property access function with no land use environmental effects. In fact, the reduction of traffic on the existing TCH, as a result of the proposed Project, would be beneficial to land users.

The twinning alternative was not considered a reasonable alternative from an economic and technical perspective.

2.1.3 Alternative Modes of Transportation

Other potential alternative modes of transportation include marine, rail and air services. To be effective, each mode of transportation would have to serve both passenger and commercial freight demands. All three of these alternate transportation modes require an inter-modal connection with a highway network to function.

There are no commercial marine services within the proposed RoW. Historically, marine transportation services were available along the Saint John River, but with the changing economics and the construction of dams at Beechwood and Mactaquac, marine transportation between Perth-Andover and Woodstock has long since ceased in this region.

Similarly, there is no air or rail services and infrastructure available within the Perth-Andover to Woodstock region. There is a small commercial airport located near Saint-Léonard, approximately 50 km north of Perth-Andover. Most of the Region's domestic air service demands are directed through the Fredericton airport and transborder service through the Presque Isle or Bangor airports.

Historically, branch lines of CP Rail extended up the Saint John River Valley from Woodstock through Perth-Andover to the CNR lines at Grand Falls and Plaster Rock. However, these lines have been



abandoned and removed over the past few decades. The CN Rail freight line that passes through Drummond is approximately 35 km north of Perth-Andover.

Although mass transport systems may alleviate or reduce certain environmental issues/concerns (e.g., air emissions), implementation of these systems does not meet with the social and economic/business needs of today's society. Also, all existing transportation alternatives would require highway infrastructure and service linkages in order to function.

In light of the enormous investment required for infrastructure, the unlikely regional demand levels required for viable alternate transport services, the need of each alternate mode for highway infrastructure, and ultimately the inability of each alternate mode of transportation to fulfil the Province's economic freight movement and traffic safety objective, the Province has not considered other modes of transportation to be viable, or technically and economically feasible alternatives to the proposed Project.

2.2 Alternative Means of Carrying Out the Project

Alternative means of carrying out this Project have included the assessment of four-lane divided highway alternatives for a new TCH alignment between Perth-Andover and Woodstock. This section describes the alignment (route) selection process undertaken by NBDOT to assess the alternate means of carrying out the Project. All alternate routes were new four-lane divided, fully access-controlled RAD 120 standard highways.

The Guidelines (Appendix A), request that the discussion of alternative means of carrying out the Project should describe the process undertaken to select the most appropriate alignment and discuss the rationale/support for selecting the preferred alignment. Also the discussion should describe any deviation from the original alignment that has resulted from public and special interest group consultations.

The selection of the preferred alternative(s) must be based on a clearly described method that includes, as a minimum, the following criteria:

- the ability to meet the Project objectives;
- option must be technically, legally and economically feasible; and
- the ability to limit the scope of the adverse effects on the natural (e.g., avoidance of wetland areas, environmentally sensitive areas and significant habitat for migrating birds and species of special concern) and human environment and to maximize the positive effects.

NBDOT produced three successive alignment alternatives that, through an iterative process of consultations with the public and input from regulatory agencies, resulted in a fourth alternative, the proposed alignment. This iterative process consisted of successive refinements to avoid or minimize



potential environmental, social, or socio-economic effects. Where it was not possible to entirely avoid certain sensitive areas or features, the alignment was modified in an effort to reduce and limit the extent of disturbance/encroachment and potential environmental effects.

Figures 2.1 A-D (Appendix B) illustrates the three alignment alternatives and the proposed alignment, on four map sheets for Perth-Andover to Woodstock identified as follows:

- Initial Alignment (*i.e.*, the first alignment alternative);
- 1998 Alignment (*i.e.*, the second alignment alternative);
- 1999 Alignment (*i.e.*, the third alignment alternative); and
- 2003 Alignment (*i.e.*, the proposed alignment).

Note that not all of the colour-coded alignments (*i.e.*, initial, 1998, 1999, 2003) are visible in all locations. This is due to the overlap of the most recent alignment (visible) over the previous year's alignment (not visible). For a given section of highway, visibility of the earlier alignment indicates that the route was changed along that section in the following iteration.

This section provides a description of the process that led to the selected alignment, described in Chapter 3.0.

2.2.1 Overview of Alignment Selection Process

The Planning and Land Management Branch of NBDOT has an established alignment/route selection process to assess the highway geometric possibilities of successive alignment alternatives that includes consideration of topographical, environmental, and socio-economic constraints. For the proposed section of TCH, the process began as part of the overall corridor planning of the TCH through New Brunswick from Nova Scotia to Quebec in 1987.

NBDOT incorporated known environmental considerations from the regulatory agencies as well as input from municipal stakeholders and the public into the development and selection of the proposed alignment. Bio-physical environmental information (*e.g.*, wetlands, moose habitat, Appalachian Hardwood Forest) and physical constraints (*e.g.*, utilities infrastructure, topography) were initially acquired. Field studies were later conducted in support of this environmental assessment and for further input to the selection of the proposed alignment. Socio-economic issues were raised by municipal and public stakeholders and modifications were made to each successive alignment to address these issues.

The alignment selection process undertaken by NBDOT is summarized below.

- Long range corridor plans were initiated for the TCH from the Quebec border to the Nova Scotia border in 1987. It was established at that time that there were few opportunities to twin the segment of



the TCH between Perth-Andover to Woodstock, and that the routing would be entirely located on the west side of the Saint John River.

- Subsequent studies to prioritize and schedule all segments of the TCH concluded that the upgrading of the Perth-Andover to Woodstock segment would wait until the period of 2004 to 2008.
- Functional route/alignment planning for the Perth-Andover to Woodstock segment of the TCH began in 1997. Two potential corridors were developed and forwarded to regulatory agencies for review and comment to identify any known environmental or physical constraints that should be considered in the alignment selection. The Initial Alignment was prepared within these limitations and presented to the public in 1998.
- Revisions were made to the Initial Alignment to accommodate input and concerns raised from the public and regulatory agencies that resulted in the 1998 Alignment.
- The 1998 Alignment was presented to the Public and further revisions were made and incorporated into the 1999 Alignment.
- The 2003 Alignment, the proposed alignment, was prepared following a third round of public consultations, and with input from environmental scoping studies and field surveys conducted in 2002 and 2003.

The following section documents the successive alignment changes made in response to the regulatory agencies, stakeholders and public, as well as the environmental background and EA Scoping surveys conducted in 2002 and 2003 for this Study. The alternative alignments and proposed 2003 alignment are presented in Figures 2.1 A-D (Appendix B). Note that the successive alignments overlay each other wherever there were no subsequent changes.

2.2.2 Route Selection

2.2.2.1 Initial Alignment

As previously indicated, the route/alignment selection process began in 1987 when NBDOT developed long range plans to upgrade all of the TCH through New Brunswick. The objective was to twin the existing TCH wherever possible. The corridors, which varied in width from approximately 400 m and 800 m, were identified and selected based on topographical, social (*i.e.*, development), traffic and design considerations. It was concluded at this time that much of the segment of the TCH from Perth-Andover to Woodstock could not be twinned without considerable social disruption due to development and land use along the existing TCH, and the associated uncontrolled access.

Although areas around Perth-Andover, River de Chute and Jacksonville/Woodstock were considered to have potential for twinning, the most significant highway section recommended for twinning was between Florenceville and Hartland. However, NBDOT later concluded that significant savings could be realized by providing a new alignment on the west side of the Saint John River between Florenceville and Hartland



by avoiding the construction of two new major bridges. The choice not to cross the Saint John River and remain entirely on the west side effectively abandoned the concept of twinning over the majority of the Perth-Andover to Woodstock segment, and greatly reduced the capital cost.

NBDOT established its implementation priorities of all segments of the TCH in the Province based on two studies, *A Highway Improvement Plan for the TransCanada Highway Through New Brunswick* in 1989 (NBDOT 1989), and *Province of New Brunswick National Highways Improvement Plan* (NBDOT 1994) in 1994. The Perth-Andover to Woodstock segment of the TCH was scheduled for construction during the final five years, 2004 to 2008, of the fifteen-year TCH construction implementation plan. Therefore, further evaluation of corridors and alignments for this proposed Project was deferred.

In 1997 the functional route planning of the Perth-Andover to Woodstock TCH segment was initiated. A consultant was retained to provide potentially viable new TCH alignments on the west side of the Saint John River between Perth-Andover and Woodstock. Two alternative corridors were identified using aerial photos. The corridors, which were each approximately 1 km in width, widening to approximately 2.5 km in the area of Wark Brook to Plant Brook, were selected based principally on topographic features, but also with the intention of avoiding agricultural land to the extent possible.

In 1998, NBDOT submitted the two TCH corridor plans for Perth-Andover to Woodstock to regulatory agencies and other stakeholders for their review and comment. They were requested to provide location and technical information with respect to their areas of responsibility, to indicate potential constraints on the corridor mapping, and to provide NBDOT with their concerns related to each of the identified corridors. The regulators and stakeholders included:

- Fisheries and Oceans Canada;
- NB Department of Fisheries and Aquaculture;
- NB Department of the Environment;
- NB Department of Natural Resources and Energy;
- NB Department of Agriculture;
- NB Department of Municipalities, Culture and Heritage;
- NB Department of Economic Development and Tourism;
- NB Power;
- NB Tel;
- Nature Trust of New Brunswick;
- Trails New Brunswick; and
- University of New Brunswick Biology Department.

Table 2.2.1 summarizes the issues and constraints identified as a result of this review.



Table 2.2.1 Constraints or Issues Identified by Regulatory Agencies and Stakeholders

Affiliation	Constraints or Issues Identified
NB Department of Natural Resources and Energy	- Identified Crown land within the corridor was limited to Crown Reserve Roads. Region 5 (Perth-Andover to River de Chute) - Identified heavy (150+ records) moose activity, which translates into significant hunting activity, toward the west side of the proposed corridor. - Identified that potential stream crossing and waterfowl impacts increase the further Route 2 is realigned westwardly. - Identified that potential "height of land" wind and drifting snow problems increase as the realignment moves west, away from the existing location. - Identified the most significant fishery issue as being the protection of the brook trout resource of the River de Chute watershed. - Identified that a movement westward away from the existing Route 2 would traverse steep terrain resulting in several difficult and expensive stream crossings. - Identified that it does not appear that any raptors nests will be affected by the corridor. Region 4 (River de Chute to Woodstock) - Identified greatest concerns as moose activity and the amount of watercourses in the proposed corridor. - Identified heavy moose and deer activity on maps and that these areas may require fencing or other methods of mitigation to control wildlife/vehicle collisions. - Identified that moving the proposed corridor closer to the existing highway would lessen impacts on wildlife and aquatic habitat. Placing the highway in more of the agricultural areas would lessen slope concerns, reduce wildlife interactions, and allow better visibility. - Identified that moose concentrations are greater the closer you move in direction to the Maine/N.B. border. - Identified that the proposed corridor encompasses many wetland and bog areas where a significant amount of waterfowl hunting occurs. These areas also provide moose habitat. - Identified that there have traditionally been bald eagle nests at Riverbank and Sproulls Island, however, the nests were not occupied in 1997. - Identified a large number of potential watercourse crossings on the corridor including a number of small lakes, a half dozen or so larger streams, and the headwaters of numerous smaller brooks. - Identified that the area within the proposed corridor, from the Waterville deadwater to Connel Road (Route 550), is inundated with numerous small watercourses. - Identified that the larger streams to be crossed, including the Guisiguit, River de Chute, Big Presque Isle, and Little Presque Isle, are all salmonid streams. Wetlands - Identified that each wetland within the project corridor identified on the wetland atlas maps and greater than 2 hectares is considered a constraint. Forest resources - Identified that the proposed corridor will have minor impacts on Crown land wood supply. - Identified the locations of five Christmas tree plantations and one sugarbush within the proposed corridor and located them on an enclosed map. Trails - Identified that the proposed corridor would intersect with the routing of the International Appalachian Trail between Fort Fairfield, Maine and Quebec. Sensitive Areas - Identified sensitive areas and environmentally significant sites on NBDOT corridor maps for their information.



Table 2.2.1 Constraints or Issues Identified by Regulatory Agencies and Stakeholders

Affiliation	Constraints or Issues Identified
Fisheries and Ocean Canada	• Identified general criteria for the protection of fish habitats 1) Where possible select an alignment to avoid the need for permanent stream diversions. 2) Ideally, select an alignment that will not interfere with the natural drainage patterns to minimize subsequent erosion and sedimentation concerns. 3) Avoid watercourse crossings that will require large fills; also avoid approach alignments that will require deep or lengthy cuts. 4) Roadway interchanges should be located away from watercourses, in order to reduce the number of unnecessary stream crossings and minimize off-site erosion/sedimentation concerns associated with the placement of large volumes of fill near watercourses. 5) Culverts should be located on straight sections of streams. 6) Culverts should be located on sections of streams with straight and level banks. 7) Culverts should be located at locations where the stream channel gradient is at or near zero, and water velocity is relatively constant upstream and downstream. 8) Road alignments should be designed to cross watercourses at right angles, which will reduce the length of the overall crossing and culvert, and also minimize the need for permanent diversions. • Indicated that the westerly alignment at the commencement of the proposed alignment is preferred due to drainage patterns within the watershed. • Indicated that within the proposed alignment, the crossing of Brown Brook and Clark's Brook should be below the junction of their tributaries to limit the number of crossings • Indicated that the proposed alignment should stay between the two tributaries of the Guisiguit Brook. • Indicated that at Harper Brook, the crossing would be preferred at the upper side of the proposed alignment.

Table 2.2.1 Constraints or Issues Identified by Regulatory Agencies and Stakeholders

Affiliation	Constraints or Issues Identified
NB Department of Agriculture and Rural Development	• Indicated that it would be desirable to consume as little as possible of the wooded land classed as good or fair on the Soil Suitability maps, as this land is our greatest opportunity for expansion of the agricultural industry in that area. • Indicated that it would be preferable not to isolate potato fields from adjacent streams, ponds, swamps, etc, as there has been considerable interest in irrigation expressed by potato producers in New Brunswick. • Identified that Byron McGrath farms on properties in Upper Knoxford extending from Route 560 to the existing highway and the proposed route will have an impact on his operation. • Identified that where the proposed route crosses the Stairs Road in Knoxford, two farms (Lakeside/Tweedie and Antworth) are bisected, and that one of these farms is developing new land directly in the proposed path. Indicated that anything to minimize the impact would help. • Identified that some of the land marked as cleared in the area of A Brown Road and J Clark Road is cropland. • Identified that the land being isolated from Brian Kilpatrick has been newly developed in the last 3 to 5 years. • Identified that several farms are being bisected by the proposed route just north of the Centreville Road. • Identified that there is the potential for the proposed corridor south of the Centreville Road to split farms or cross between two farms owned by the same landowner in the St. Thomas area. Proposed route to the east of the existing TCH from Waterville to Woodstock : • Identified that a farm is located at the northern end of this proposed route on both sides of the existing TCH and would be bisected on both sides by the proposed route splitting the property in four. As well, a large portion of the remaining land on this property would be taken for an interchange resulting in a loss of excellent potato land. • Identified that a recently developed farmland to the south of the above property would lose a good chunk of farmland as a result of this route. • Identified that any farm in the area where the proposed route crosses the Rosedale Road until it rejoins the existing TCH in Woodstock will be impacted significantly as the farms will be crossed either diagonally or lengthwise, which would present a real problem for farmers employing 66 to 90 foot wide sprayers. Proposed route to the west of the existing TCH from the proposed Waterville overpass to Woodstock • Identified the existence of potato farms on both sides at the Little Presque Isle Stream and the Waterville Road. • Identified that the Waterville overpass should have little or no impact on agriculture. • Identified that several farms would be bisected as the proposed route passes from the Ore Hill Road to connect with the existing TCH at Woodstock. • Identified that potato farms would likely be impacted in the Hopkinds Road area. • Identified that several farms will be bisected in the area of the Burtt road and south to Iron Ore Hill Road.



Table 2.2.1 Constraints or Issues Identified by Regulatory Agencies and Stakeholders

Affiliation	Constraints or Issues Identified
NB Department of Environment	• Identified that the proposed corridor does not cross any watersheds used for municipal drinking water supplies. • Identified an Environmentally Significant Area (#499) within the proposed highway corridor. • Identified an area, either in or near the corridor, which contains a very rare species of plant <i>Dentaria laciniata</i>, and indicated it on an attached map. • Identified the location of an <i>Eleocharis</i> species on the map as well. • Requested that the proponent contact The Nature Trust of New Brunswick to obtain more information about the three above sites and their precise location, so as to avoid endangering these habitats.
New Brunswick Department of Fisheries and Aquaculture	• Identified that their predominant concern in Plan 1 is with the crossings in the Harper Brook, Lanes Creek area near the Wakefield Parish line. Requested to reserve the opportunity to review further engineering concepts in relation to this crossing. • Identified that their predominant concern and interest in Plan2 is in the proximity of the corridor to the Saint John River in the vicinity of Demerchant-Plant Brook, and again on the outskirts of Andover, on both sides of Wark Brook. Requested to reserve the opportunity to review further engineering and mitigation plans in relation to this portion of construction.
New Brunswick Department of Municipalities, Culture, and Housing	• Identified that the westerly option between Woodstock and Hartland seemed to pose the most constraints. • Indicated that they would prefer the route avoid, as much as possible, locations which would place the highway in close proximity to existing built-up areas and existing communities and are especially concerned with the route location around the community of Jacksonville overpass and the existing developments located adjacent to Lockart Mill, Kinney, and Ore Hill Roads. • Identified that the westerly route contains the greatest portion of agricultural lands and the greatest portion of wetlands of the two options. • Identified that the westerly option would also encounter the largest number of property acquisitions. • Identified that the westerly route would require a number of existing road crossings or fills including Iron Ore Hill, Route 560, an unnamed crossroad, Waterville Road, and the Little Presque Isle Stream at Waterville. • Identified that the easterly route option is longer and may require additional infrastructure due to increased existing road crossings and fills required, however this may be offset as there are fewer settled areas which may be impacted. • Identified that from Waterville through to Florenceville there will be only limited impacts to existing communities beyond those at the crossings of the St. Thomas and Centreville Roads.

Table 2.2.1 Constraints or Issues Identified by Regulatory Agencies and Stakeholders

Affiliation	Constraints or Issues Identified
	• Identified that an interchange at the Waterville and Centreville crossings is extremely important as it would provide access to the only other international border crossing between Woodstock and Limestone (other than River de Chute which is seasonal). • Identified that there are no direct community concerns about the route in northern Carleton and Victoria counties, however, there is a general concern regarding the amount of cut and fill required for the route in that area. Identified that the area is known for its ravines and hardwood ridges, therefore, route locations that chose to minimize the extent of the cuts would be preferable. • Identified that there are no local land use planning Regulations in effect for the proposed corridor. • Identified that all municipalities have municipal plans and zoning by-laws in effect, which may need to be amended, should the proposed corridor cross their respective boundaries.
Nature Trust of New Brunswick	• Identified that as many as nine Appalachian Hardwood Forests (AHF) may lie in whole or in part within the proposed corridor and marked the boundaries of the nine forest sites on a map. • Indicated that one of the sites has been rated as having a very high priority for protection.
Environment Canada	• Recommended that the highway corridor avoid all protected areas, and that Ducks Unlimited be contacted in order to ensure that the proposed road does not impact their sites in the area. • Recommended that the highway corridor avoid all environmentally significant areas. • Recommended that Dr. Harold Hines and Jim Goltz be contacted in order to ensure that rare plants in the area are not impacted by the proposed highway. • Suggested that the New Brunswick Department of Natural Resources and Energy be contacted for information on raptor nests in the area and appropriate mitigation measures. • Recommended that the proposed highway avoid all wetlands in the area. • Assumed that the TCH right-of way would veer west of the current TCH (Route 2) and avoid any flood plain areas. • Identified that the current Canada-NB Flood Damage reduction Agreement, the federal and provincial governments have agreed to ensure that its departments and agencies do not engage in undertakings in designated areas and that no further financial assistance will be given to undertakings vulnerable to flood damage in the designated areas. • Requested that selection of stream crossings take into account the need to ensure flood risks are not increased due to loss of flood plain storage or river ice constrictions. • Requested that bridge designs and approaches incorporate above requirements.

In consideration of the issues and constraints summarized in Table 2.2.1, NBDOT developed a single alignment (the Initial Alignment) for presentation to the general public. The Initial Alignment also considered technical highway design elements and topographic features. Where environmental and socio-economic constraints could not be entirely avoided by the alignment, NBDOT attempted to limit the environmental effects of the proposed TCH on these features to the extent possible through design modification.



NBDOT held meetings with the towns of Woodstock and Hartland and the villages of Florenceville and Perth-Andover, and organized four public information sessions to present functional plans of the Initial Alignment of the TCH in 1998 (Figures 2.1 A-D, Appendix B). This Initial Alignment was also provided to the regulatory agencies and stakeholders for further review.

Overall, there was strong support for the Project, as it would result in substantial improvement in the transportation network and traveler system. The expected benefits would be time savings and improved safety for those using the proposed TCH, as well as for local traffic that would remain on the existing TCH. The removal of much through traffic, passenger vehicles and trucks, from the existing TCH will enhance the development of the River Valley as a scenic route for touring, hiking and biking. This will also benefit farmers of the region who, due to increasing concentration of small farms into larger farms, increasingly use the existing TCH as a local access road connecting their fields and operations.

The issues raised by the public and stakeholders included:

- The need for realignment to avoid severance of active farmland;
- The need for realignment to avoid the severance of the community of Jacksonville (Figure 2.1 D, Appendix B);
- Modifications required to the Lockhart Mill Road and Connell Road connections to the proposed TCH (Figure 2.1 D, Appendix B);
- The need for additional interchange access along the new TCH, particularly at Route 560 (River de Chute) (Figure 2.1 B, Appendix B);
- The commercial environmental effects of highway traffic by-passing existing businesses located along the existing TCH and the potential for future commercial development and public infrastructure to gravitate to the proposed TCH corridor (at the expense of communities located along the existing TCH);
- The severance of properties from future development plans, such as woodlots, subdivisions and business expansions; and
- The environmental effect of the proposed TCH on adjacent residential property access and values, and resident livelihood.

2.2.2.2 1998 Alignment

NBDOT prepared a new alignment in 1998 with changes from the Initial Alignment. Realignments or other design mitigation measures were accommodated, where feasible, to address the concerns of the public and regulatory agencies. The majority of alignment changes made were related to avoidance of as much farmland as possible. In addition, moose habitat, Appalachian Hardwood Forest lands, residential and commercial properties, and recreational trails and hunting camps, as provided in Figure 2.1 A-D



(Appendix B), were avoided to the extent possible. Other changes to the Initial Alignment were made to avoid streams that ran parallel to the alignment.

Specific changes made in 1998 to the Initial Alignment, as a result of public input, are summarized in Table 2.2.2 and illustrated in Figures 2.1 A-D (Appendix B).

Table 2.2.2 Summary of Key Changes to Initial Alignment Based on Regulatory, Stakeholder and Public Input

Constraint	Alignment Modification
Agricultural Land	- Alignment shift to the west to avoid or limit encroachment on valuable agricultural land between Perth-Andover and Beaconsfield Road (Figure 2.1 A, Appendix B). - Alignment shift to the west of agricultural lands north of Scott Road. The resulting change in approach to Scott Road required some modifications to accommodate a new Scott Road grade separated overpass (Figure 2.1 A, Appendix B). - The routing at Backland Road was moved west to improve the alignment and structure location, and reduce the encroachment upon agricultural lands (Figure 2.1 B, Appendix B). - Alignment shift to the west between Lanes Creek to Route 560 (south) to improve the location of the alignment passing through farmland. It also avoided some residential properties (Figure 2.1 D, Appendix B).
Sensitive/Critical Habitat	Alignment shift to the west to avoid/limit encroachment on moose habitat area between Scott Road and Route 560 (Figure 2.1 A, Appendix B).
Residential Property / Property Severance	- The alignment at B. Smith Road was moved west to avoid residential properties. The previously planned grade separation to overpass the highway at J. Clarke Road was moved to B. Smith Road (Figure 2.1 B, Appendix B). - The alignment between Big Presque Isle Stream and Raymond Road shifted slightly east and west to reduce the extent of property severances (Figure 2.1 C, Appendix B). - Alignment shift to the east between the Hartland Interchange to about 1.5 km south of Estey Road to avoid some properties. This alignment also conformed with the highway geometric changes associated with the relocation of the Hartland Interchange to the east (Figure 2.1 D, Appendix B). - Most residential areas were avoided by the proposed alignment. Where residences were unavoidable, NBDOT has or will negotiate fair compensation with property owners.
Cost	The River de Chute/Route 560 crossing structure was replaced by two separate smaller structures in each direction over the stream and the road (Figure 2.1 B, Appendix B).
Social/Socio-Economic	NBDOT's proposed new alignment and interchange connections were chosen to parallel and to interconnect with the existing alignment to continue to serve existing developments and communities (e.g., the Hartland Interchange was moved east to be somewhat closer to the town).

2.2.2.3 1999 Alignment

In 1999, a series of public meetings were held to present the 1998 Alignment to the public for comment and input. In general, the 1998 Alignment was well received by the public, although some farmers still expressed concern with the alignment across their farmland. Most of the residential property owners and business operators directly affected by the proposed TCH requested that property ownership negotiations be finalized immediately. Concerns, especially from the business community, were expressed regarding the lack of an interchange between Perth-Andover and Florenceville. Residents of J. Clark Road, B.



Smith Road and Backland Road expressed concerns with the proposed grade separation crossing locations.

Residents of Jacksonville and surrounding areas expressed concerns related to the close proximity of the alignment to their area. Representatives of the Town of Woodstock were concerned with the proposed elimination of the southbound off-ramp located at the northwest quadrant of the TCH/Route 550 (Connell Road) Interchange.

Other comments included concerns related to property access and wildlife management, as the 1998 Alignment was in the vicinity of areas known for deer and moose activity. Refer to Section 4.2.1 for a complete summary of stakeholder consultation efforts, issues and resolution.

As a result of the 1999 public meetings, a new alignment was developed in consideration of the comments and issues raised. This alignment, referred to as the "1999 Alignment" is illustrated in Figure 2.1 A-D (Appendix B). This alignment was not formally presented to the general public for further review.

2.2.2.4 2003 Alignment

On several occasions, NBDOT was contacted by stakeholders and the general public requesting an opportunity to review the revised alignment (*i.e.*, 1999 Alignment). This resulted in a number of alignment adjustments. For example, the 2 km section north of Palmer Road was realigned to the east and the 2 km section south of Palmer Road was realigned to the west (Figure 2.1 D, Appendix B). These changes were in response to comments made by local, affected farmers who indicated/provided a preferred alignment that would reduce the extent to which the proposed TCH would affect agricultural land in this area. This realignment also avoided two stream crossings over a tributary of the Little Presque Isle Stream.

Landowners in the area between the Big Presque Isle Stream and Raymond Road indicated the presence of poorly drained soils and moose habitat that were not obvious from available mapping. As a result, the 10 km section was realigned to the west of the 1999 alignment (Figure 2.1 C, Appendix B). Although not all of the moose habitat was completely avoided, the 2003 realignment minimizes disruption to these habitats. This realignment also took into account the engineering and economic considerations of moving from a fill section to a cut section. The relocation to the west along the Big Presque Isle Stream bridge also avoided a cottage and a new pottery kiln.

NBDOT commissioned a number of background environmental data surveys in 2002 and additional surveys in 2003 in support of this environmental assessment. A number of realignments were made as a result of the issues identified during these surveys and subsequent consultation with regulatory agencies. The 2003 Alignment was presented to the public in June of 2003. Table 2.2.2 summarizes the



realignments made to the 1999 Alignment. Additional information related to the alignment changes summarized in Table 2.2.3 are included in the discussion of the respective Valued Environmental Component in Section 5.0.

Table 2.2.3 Summary of Key Changes to Initial Alignment Based on Regulatory, Stakeholder and Public Input

Constraint	Alignment Modification
Rare Plants	- Alignment shift to avoid rare plants and Appalachian Hardwood Forest habitat characteristics between Hillandale (north of Beaconsfield Road) and south of River de Chute (shift to the west from Hillandale to Plant Brook; shift to the east from Plant Brook to Brown Brook/Scott Road; shift to the east from Scott Road to Graham Brook and River de Chute area) (Figure 2.1 A, Appendix B). - The median was reduced to the minimum width of 30 m between Guisguet Brook and B. Smith Road to avoid/minimize encroachment on rare plants (Figure 2.1 B, Appendix B). - Alignment shift to the east for 1.5 km north of Palmer Road to avoid rare plants (Figure 2.1 D, Appendix B). - Hartland Interchange shifted to the south to avoid rare plants (Figure 2.1 D, Appendix B).
Project Cost	The bridge at River de Chute and the overpass at Route 560 were combined to a single structure, in each direction, similar to the proposed Initial Alignment (Figure 2.1 B, Appendix B).
Watercourses	The median was reduced to the minimum between Guisguet Brook to B. Smith Road to avoid/minimize encroachment on watercourses (Figure 2.1 B, Appendix B).

2.2.2.5 Summary of Alignment Selection Process

Selection of the preferred/proposed TCH alignment was an iterative process with many opportunities for public, stakeholder and regulatory participation. The proposed alignment avoids or minimizes environmental effects to the extent that is technically and economically feasible in consideration of known or identified environmental constraints.

2.2.3 Watercourse Crossing Alternatives

Inherent in the installation and operation of any watercourse crossing structure is the potential for adverse environmental effects. They are briefly summarized for the construction phase as follows:

- blasting in or near water has the potential to have significant impacts on fish and fish habitat;
- potential increase in erosion and run-off to watercourses;
- increased water temperatures in the downstream cleared area;
- decreased vegetation resulting in decreased food and cover for fish;
- noise and vibration disturbance during construction activities could cause fish avoidance;
- direct fish mortality could result from accidental spills;
- potential exposure of acid generating rock can lower pH in watercourse; and
- water control structures could effect water hydraulics.



Potential effects identified in the watercourse crossing structure operation phase include chronic soil erosion, increased water temperature, destruction of fish habitat and changes in watercourse hydraulics, which could impede fish passage (DFO 1999a). Improper structure installations can compound the effects. Higher velocities, compared to natural waters, can develop in crossing structures because they have lower roughness coefficients or steeper slopes. High velocities above and below a crossing structure caused by culvert hydraulics and elevated outlets can also block passage. Oversized structures or structures with steep gradients can produce shallow water conditions which can block fish passage. Potential soil erosion and sediment control are also a major factor associated with crossing structure placement and operation, particularly for proposed stream crossings located downslope of cut and fill areas. These areas can remain as long term problematic erosion sites if not properly designed in the initial planning stages (DFO 1999a).

Understanding the potential effects associated with watercourse crossing structure operation activities is important so that design criteria can be incorporated into the planning and design phases to minimize or avoid potential adverse effects of the project (DFO 1999a).

For the Project, each watercourse crossing will be considered on a case by case basis to determine the type of structure to be installed. A number of considerations will be taken into account when detailing the design of each crossing. This will include characteristics such as drainage area, size of streambed, fill height, soil conditions, rare plant presence, wildlife crossings, minimal fish habitat alteration, disruption or destruction and maintaining navigable waters where applicable. However, foundation permitting, the larger crossings may use an approved open-bottom structure. Open-bottom structures will only be used where stream diversion is minimal. The need for, and the extent of, HADD compensation will be decided on a case by case basis.

In consultation with Coast Guard (Navigable Waters) representatives, determination of navigable waters has been completed for all 43 watercourses crossed by the Project. The following five watercourses were determined to be navigable.

- WC18 – River de Chute
- WC33 – Big Presque Isle
- WC35 – Tributary to Little Presque Isle
- WC36 – Little Presque Isle
- WC37 – Little Presque Isle

The watercourses that were determined to be navigable are not used for any known commercial trafficking of goods, or for transportation purposes. They may be used during open water months for light recreational and sporting use (*i.e.*, canoe or small jon boat). Table 2.2.4 presents some key characteristics of each of the watercourses that were determined to be navigable. The channel width is presented,



however actual wet width at the time of survey (i.e., late summer 2002) was approximately 25% less than channel width for each watercourse. The average channel depth was also recorded in late summer, and is reflective of low water conditions. The percentage of the substrate that is composed of rubble or larger sized clasts is presented to provide an indication of potential obstacles to motorized propeller use, or deep hulled boats. In all cases except for Tributary to Little Presque Isle, depth and substrate composition preclude the use of outboard motors or deep hulled watercraft. The Tributary to Little Presque Isle, although sufficiently deep with a soft substrate, has a very small channel width of 2.5 m, and is blocked by beaver dams above and below the area crossed by the proposed RoW.

Table 2.2.4 Characteristics of Navigable Waterways

Watercourse Name	Channel Width (m)	Average Channel Depth (m)	Percentage of Substrate Composed of Rubble, Rock, or Boulder
River de Chute	9	0.25	75%
Big Presque Isle	47.1	0.20	65%
Tributary to Little Presque Isle	2.5	>1	0%
Little Presque Isle	16.1	0.17	85%
Little Presque Isle	15	0.50	30%

During the course of the *CEAA* review process, the public have an opportunity to comment on navigational use of the watercourses crossed by the Project. No navigational use was identified during the NBDOT alignment selection public consultation process. During the advertisement period for the approval process under *Navigable Waters Protection Act* subsection 5(1), the public will again have an opportunity to comment on the potential of the Project to affect navigation. The watercourse crossing structures at these 5 locations will be designed in consultation with Navigable Waters Protection officers, and in consideration of issues raised during public consultation, to ensure that there are no adverse impacts to known and/or identified navigability.

Design of watercourse crossing structures will be conducted in consultation with DFO and Navigable Waters Protection Program (NWPP) officers to ensure HADD and navigable waters issues are addressed in the planning stages. Watercourse crossing structures for fish-bearing watercourses will be selected in order to minimize HADD and comply with the *Guidelines for the Protection of Fish and Fish Habitat – Placement and Design of Large Culverts* (DFO 1999a). These guidelines include provisions to ensure fish passage is not impeded throughout the year by accommodating the high velocities associated with high flows as well as, the shallow flows associated with low flows, into the overall culvert design.



Figures 2.2 and 2.3 provide generic outlines of temporary water control structures for an open channel option and a generic plan for a typical watercourse crossing, respectively.

The watercourse crossing structure for each crossing will be one of four potential structures including: pipe culvert; box culvert; arch; and bridge. As per the NBDOT Standard Specifications (2003) these structures can be classed into two large categories: culverts and open bottom structures (arch and bridge). Figure 2.4 illustrates typical sections for each of the box culvert, pipe culvert and arch. A generic profile of a conventional bridge is presented in Figure 2.5. The NBDOT Standard Specifications (2003) refers to a bridge as "any structure in excess of 3 m in span length carrying vehicular and/or pedestrian traffic"; and a culvert as "any structure not classified as a bridge, and/or drainage system, which provides an opening for the passage of water under any roadway or driveway".

General guidelines that will be used by NBDOT (or the developer) in the selection of watercourse crossing types are listed below.

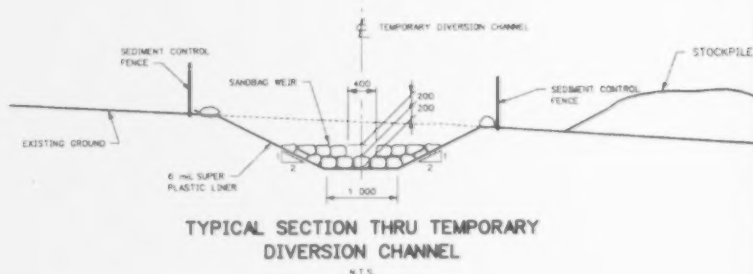
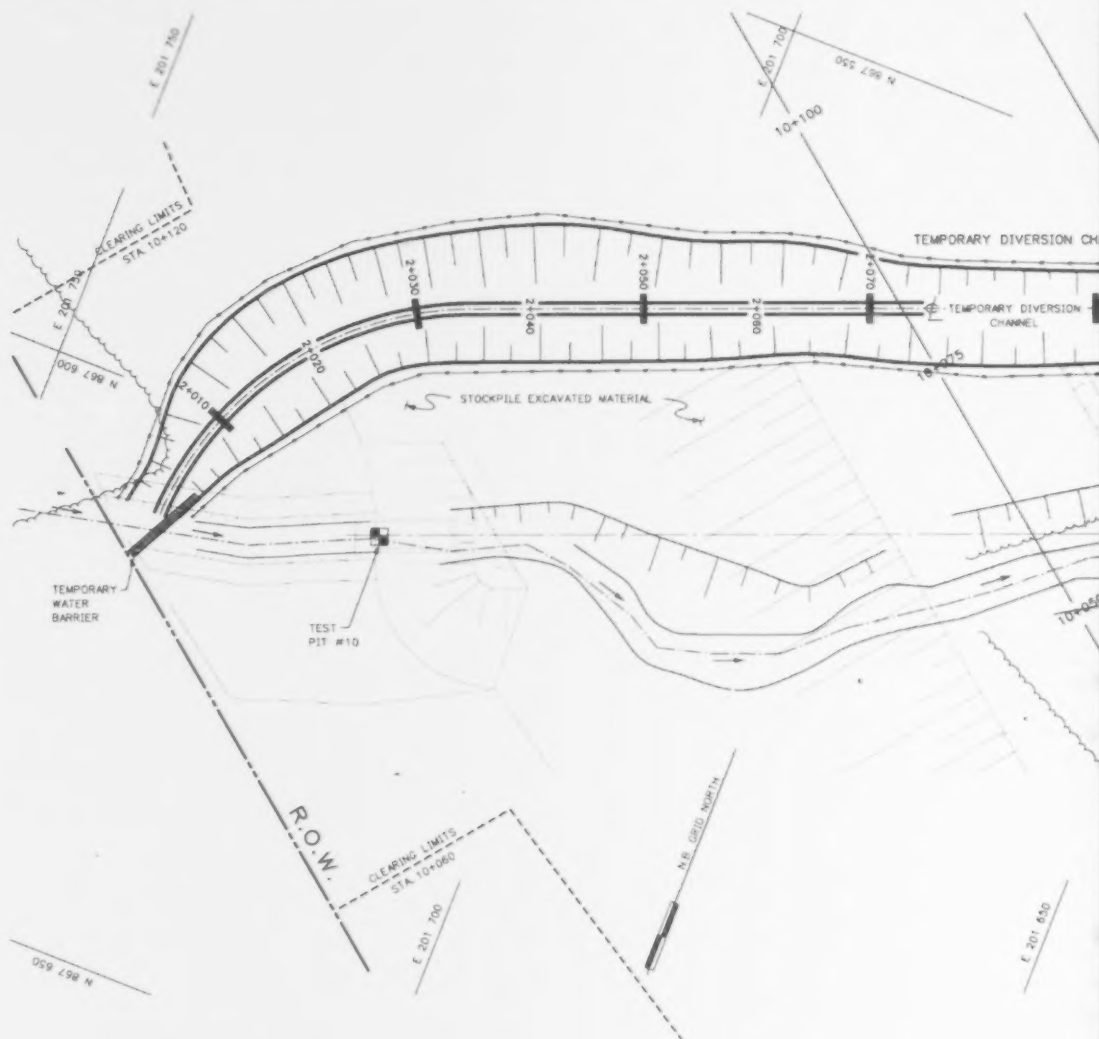
Culverts

- For higher fills (greater than 9 m), round concrete culverts are preferred because they can utilize a cost effective induced trench design.
- For lower fills (less than 9 m), precast box culverts are preferred.
- Aluminum multiplate pipe (round) is a viable option assuming that bedload abrasion is accounted for (plates of excess thickness on the bottom half).
- Aluminized Type 2 culverts (round) are also viable options but are only available with a maximum diameter of 3.3 m.
- Drainage areas amenable to culvert installation are generally less than 100 km².

Arches

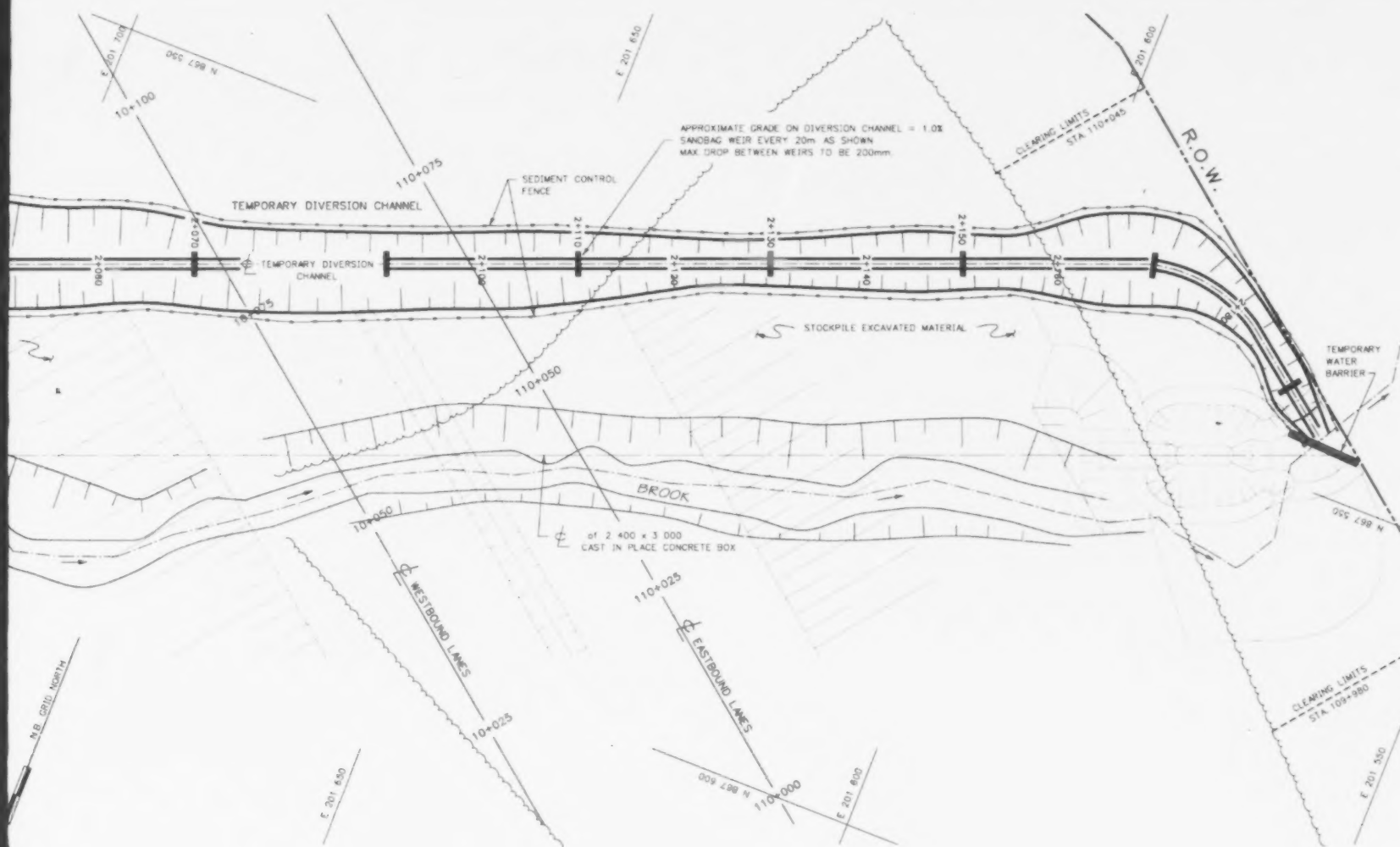
- Arches are used for relatively large waterways under deep fills, if rock or favourable soil conditions exist for footings. Arches that are not founded on rock tend to have large footings, which often result in the destruction of the natural streambed.





REFERENCE:
DEPARTMENT OF TRANSPORTATION
TEMPORARY WATER CONTROL OPEN CHANNEL OPTION

TYPICAL WATERCO
NEW ROUTE 2 TR
PERTH-A

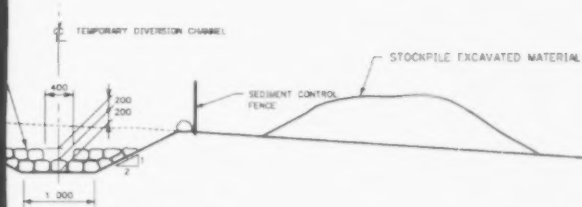


DRAINAGE AREA = XX km²

TYPICAL CONSTRUCTION SEQUENCE

The following sequence of work shall be followed, unless otherwise directed by the Engineer. The Owner shall be receptive to alternative approaches to temporary water and sediment control procedures.

1. Mulch all exposed soils as work progresses.
2. Construct Temporary Diversion Channel complete with sandbag weirs, then install Sediment Control fence in as shown.
3. Install Temporary Water Barriers and divert stream flow, and rescue fish from bypassed channel.
4. Install new culvert and construct Downstream Pool and Upstream Channel, Plant Trees.
5. Remove Temporary Water Barriers to open new channel, and rescue fish from Temporary Diversion Channel.
6. Fill and Mulch areas which have been disturbed.
7. Place remainder of fill to design grade, Hydroseed areas which have been disturbed.



SECTION THRU TEMPORARY DIVERSION CHANNEL

TYPICAL WATERCOURSE - OPEN CHANNEL OPTION
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 04

Job No.:
14677

Scale:
N.T.S.

Fig. No.:
2.2



Jacques Whitford

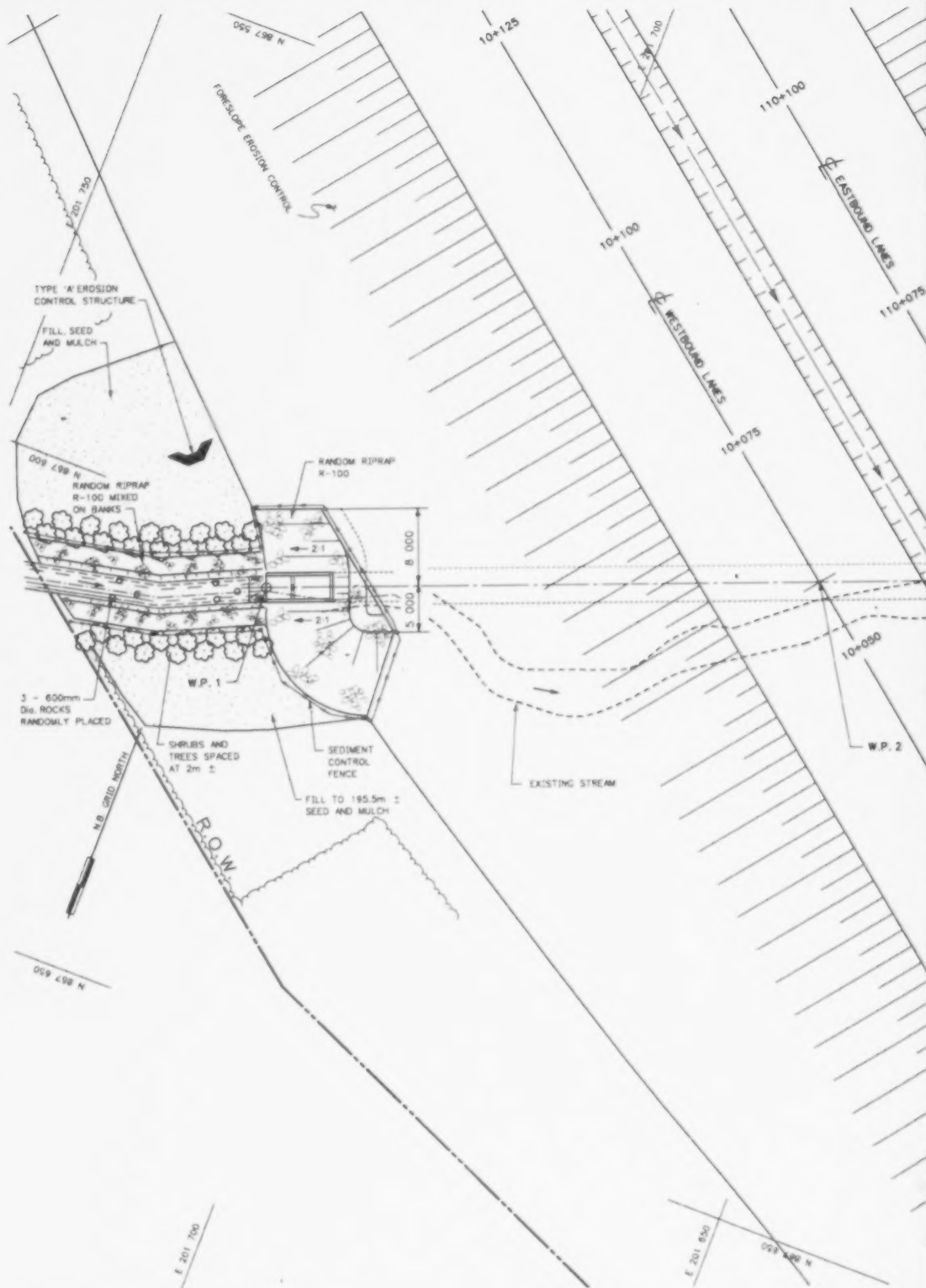
Consulting Engineers
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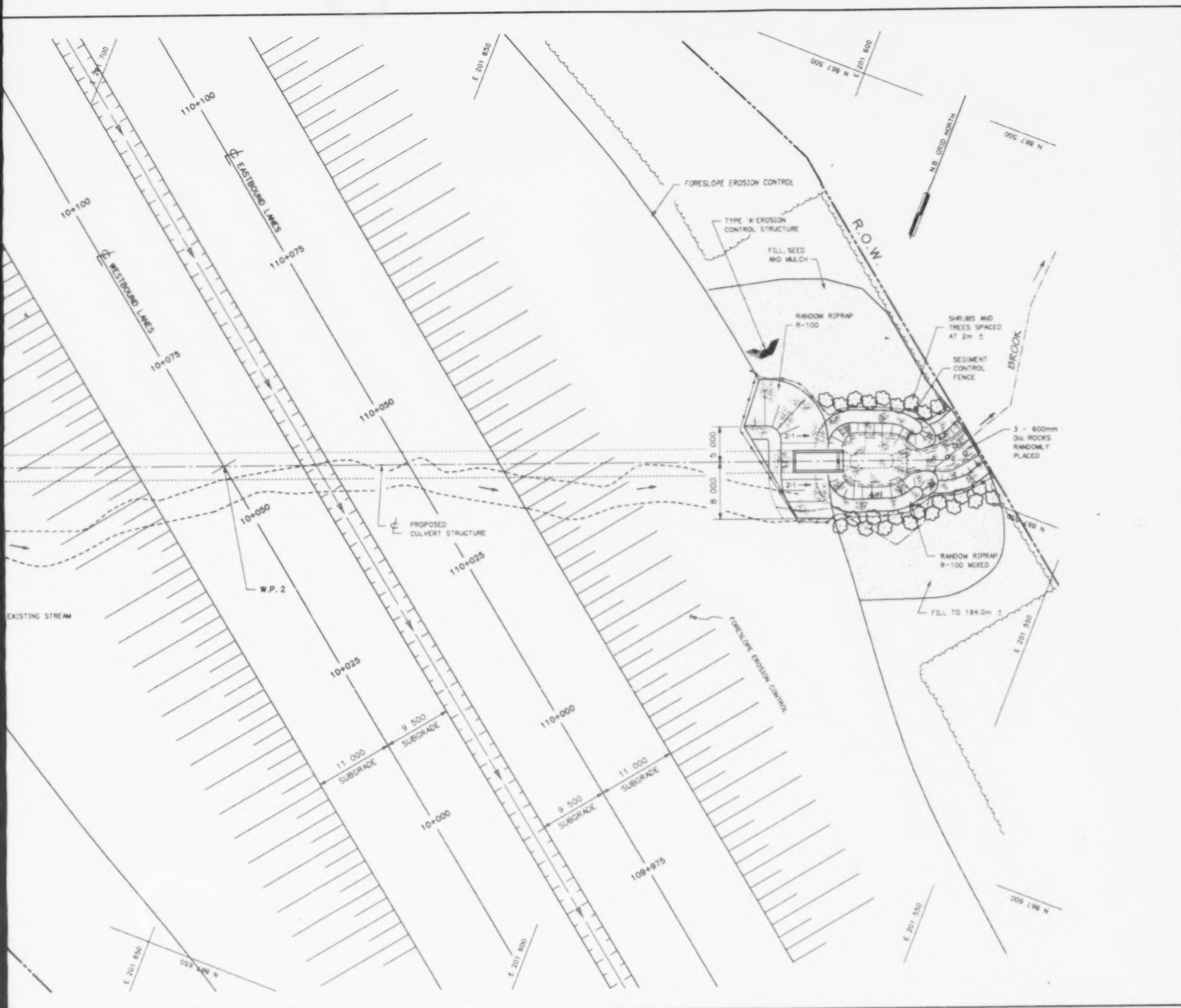
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FILE: 14877\WORKING\F02-3_CROSSING

REFERENCE:
DEPARTMENT OF TRANSPORTATION
PLAN - TYPICAL WATERCOURSE CROSSING

PLAN VIEW OF TYPICAL
NEW ROUTE 2 TRAIL
PERTH-ALBERTA





PLAN VIEW OF TYPICAL WATERCOURSE CROSSING
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 04

Job No.:
14677

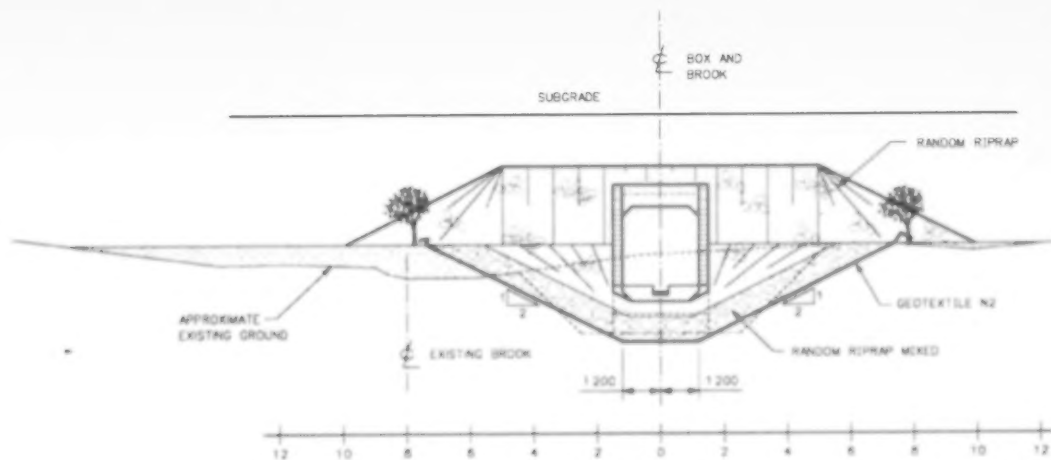
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Fig. No.:
2.3

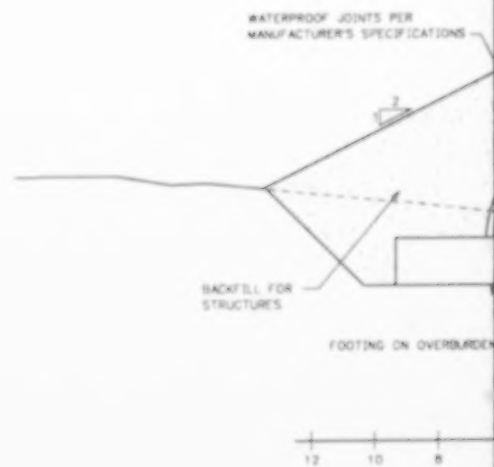


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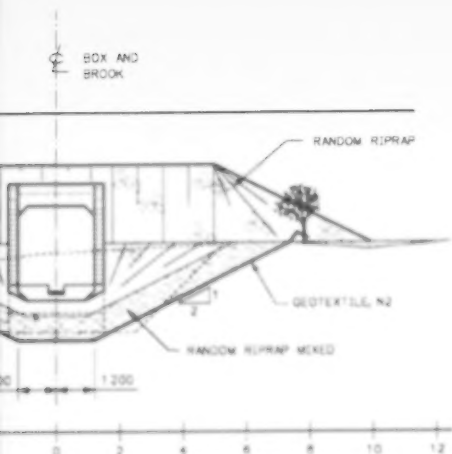
SECTION THRU OUTLET POOL.
BOX CULVERT OPTION



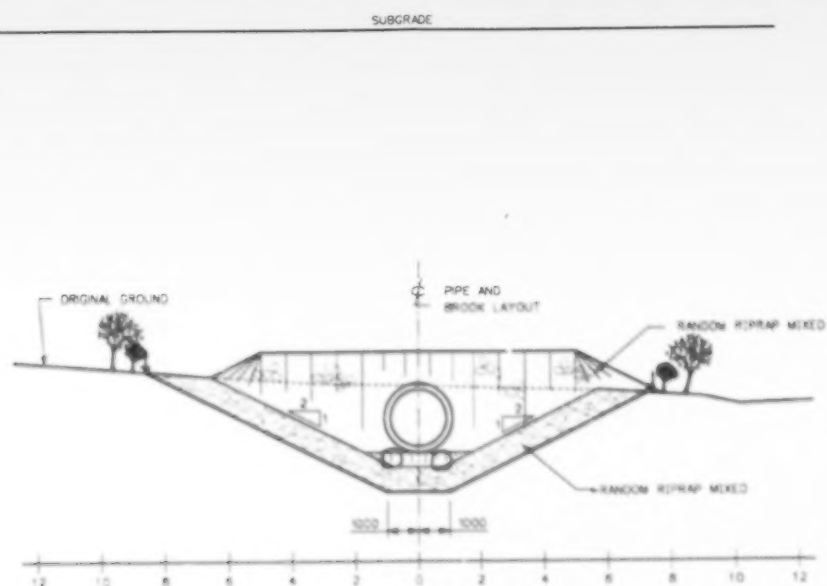
FILE: 14677\WORKING\FIG2-4_SECTIONS

REFERENCE:
DEPARTMENT OF TRANSPORTATION
TYPICAL SECTIONS

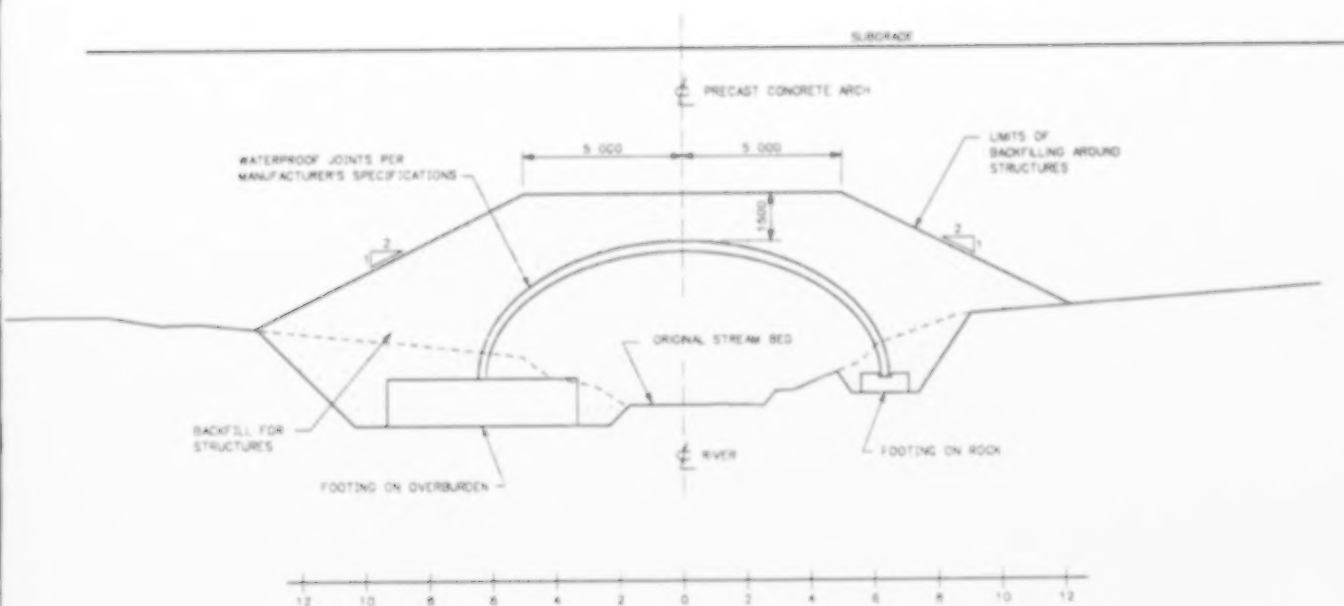
PROFILE OF TYPE
NEW ROUTE 2 TR
PERTH-A



THRU OUTLET POOL
CULVERT OPTION



SECTION THRU OUTLET POOL
ROUND PIPE OPTION



SECTION
ARCH OPTION

PROFILE OF TYPICAL WATERCOURSE CROSSINGS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 04

Job No.:
14677

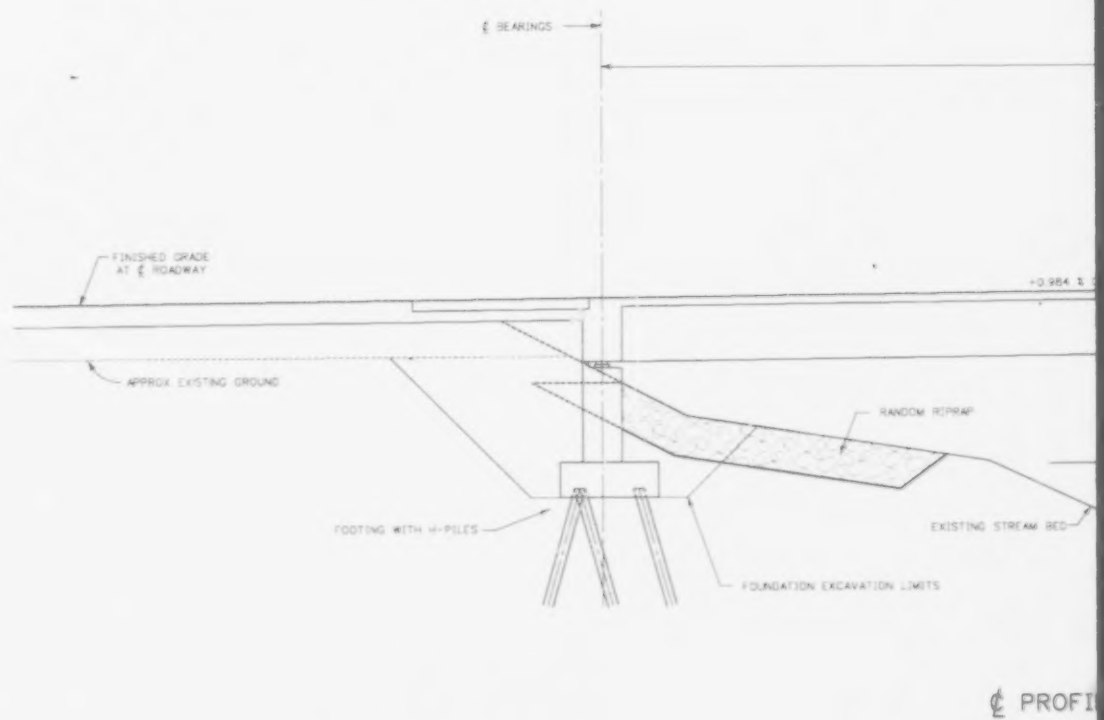
Scale:
N.T.S.

Fig. No.:
2.4



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⌘ PROFILE

FILE: 14877\WORKING\FIG2-5_BRIDGE

REFERENCE:
DEPARTMENT OF TRANSPORTATION
⌘ PROFILE OF CONVENTIONAL BRIDGE

PROFILE OF
NEW ROUTE 2 TR
PERTH-A

Bridges

The need for a conventional bridge crossing is generally dictated by larger drainage areas and navigable waters issues.

In the design stage, DOT will also take into consideration the types of materials to be used for construction and the crossing layout. The following general guidelines will be considered in the Project design stage.

In accordance with DFO (1999), NBDOT has committed to consideration of the following guidelines during watercourse crossing planning and design. Where possible:

- highways will cross streams at right angles to minimize the length of a crossing and minimize the need for permanent stream diversions;
- watercourse crossings will be located on straight stream segments;
- watercourse crossings will be located at sites where the channel gradient is at or near zero and water velocity is relatively constant upstream and downstream;
- crossing locations will be avoided that will require large permanent stream diversions;
- roadway interchanges near watercourses will be avoided as these will normally require multiple crossing structure installations and the placement of large amounts of fill adjacent to the watercourse;
- areas with erodible soils will be avoided;
- areas with acid-generating rock will be avoided;
- watercourse crossings at sites where culvert installation will involve large fills or approaches with deep or lengthy cuts will be avoided; and
- natural drainage patterns will be retained.

In addition, structure designs will be based on established watercourse conditions (e.g., stream diversions should mirror stream gradient, substrate, meander, sequence, depth, and riparian vegetation). Specific watercourse conditions can be found in Section 5.3 (Surface Water VEC).

2.2.4 Ancillary Facilities Alternatives

The exact locations of ancillary facilities have not been determined at this time. The following subsections provide information regarding the process for selection of suitable sites.



2.2.4.1 Waste Disposal Areas

Waste disposal areas will be selected in accordance with:

- Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site; and
- Item 947 of the NBDOT Standard Specifications, January 2003.

2.2.4.2 Borrow Pits and Quarries

The developer must apply for a permit (Application Form Requesting the Approval of a Source) with the Department of Environment and Local Government for approval to operate the facility. Section 4.9 of the EPP indicates that the location and suitability must be approved by the engineer and must be developed and operated in accordance with all applicable provincial guidelines, policies, acts, and regulations, including:

- Items 922, 941, 936, 947, and 948 of the NBDOT Standard Specifications (January 2003);
- Draft Provincial Land Use Policy Pits and Quarries;
- Draft Provincial Performance Standards for Development, Operation, and Closure of Pits and Quarries in New Brunswick; and

2.2.4.3 Removal or Modification of any Existing Structures

Residential wells located on the property are decommissioned as per the NBDELG Guidelines for decommissioning (abandonment) of Water Wells. Septic tanks must be pumped clean and backfilled or completely removed and backfilled.

2.2.4.4 Asphalt Plant(s) (Construction, Installation and Operation)

The location of an asphalt plant is chosen by the developer prior to construction and must be approved by the Engineer. The plant and its components will be in compliance with ASTM D995-95b (Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures) and the contract documents. In addition, the developer must apply for a Request for Approval of a Source from the Department of Environment and Local Government. Generally the developer would already have acquired such a permit however if the asphalt plant were portable the developer would have to apply for an amendment to locate the portable plant at a new location each time the plant is moved. Asphalt plants are generally located outside the RoW as they take up too much space during construction.



3.0 PROJECT DESCRIPTION

This section of the report provides an overview of the proposed Project, its purpose and location, and describes the elements and activities to be undertaken as part of the Project, including a description of potential malfunctions and accidental events that may occur throughout the life of the Project. This section of the report also provides a description of the proposed environmental management practices to be employed for each of the proposed Project phases.

3.1 Project Overview

3.1.1 Project Definition and Location

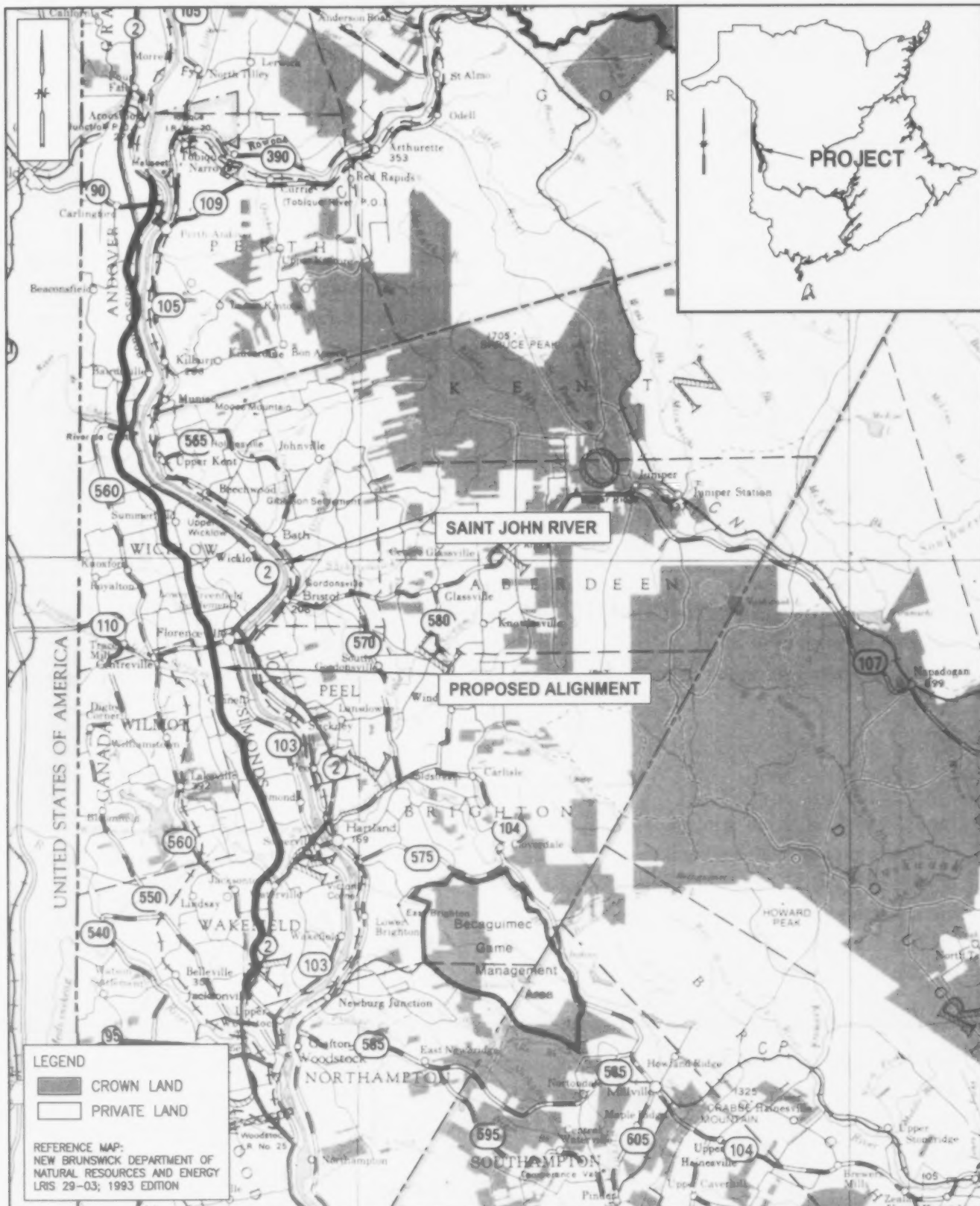
The Project consists of the construction, operation, and maintenance of a new four-lane divided controlled access highway, approximately 70.7 km in length, that will by-pass the existing two-lane TCH, including interchanges and watercourse crossings and structures, and required ancillary work/facilities including new road connections, property access roads, and borrow and disposal areas. This new section of the TCH will be located in western New Brunswick, and will extend north/south between the Village of Perth-Andover and the Town of Woodstock, as shown in Figure 3.1 and Figure 3.2 (Appendix C). The proposed TCH alignment is located west of the existing TCH, between the Saint John River and the United States border. As such, the proposed TCH will not require/include new major bridge structures to cross the Saint John River.

The northern portion of the Project is located in Victoria County, and the remaining southern portion is located in Carleton County. The proposed TCH will originate at a point just south of the new Route 190 Interchange at Perth-Andover (presently under construction) and continue in a southerly direction west of the existing TCH, by-passing Florenceville and Hartland, and will terminate at the Route 550 (Connell Road) Interchange at Woodstock. Figures 3.2 A-D (Appendix C) present the proposed TCH alignment from Perth-Andover to Woodstock. With the exception of short twinned sections at each end (a 2.8 km segment from the Route 550 Interchange to a point about mid-way between Lockhart Mill Road and Route 560 in Jacksonville, and a 1 km segment extending south from the Route 190 Interchange), the proposed TCH will be constructed over a new alignment that will by-pass the existing TCH.

The proposed Project footprint is the minimum area within which all construction activities associated with the proposed TCH will take place. The Project footprint includes the area for the main lanes and interchanges of the proposed TCH, all new and modified secondary roads and all new woodlot or property access roads required by the Project, as well as the potentially affected areas surrounding streams at watercourse crossings.









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Fig. No.:
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NBDOT plans to complete construction of the Project in four years beginning in 2004 and ending at the conclusion of the 2007 construction season. To date the Project has undergone the functional planning process to select an alignment as described in detail in Section 2.2 of this report. NBDOT preliminary pre-design construction costs of the Project are estimated at \$200 million.

3.1.2 Proposed Highway Design

The proposed TCH will be designed and constructed to RAD 120 (Rural Arterial Divided highway with design speed of 120 kph) Transportation Association of Canada (TAC) Standards, allowing the planned posted speed of 110 kph. Typical cut and fill cross-sections are illustrated in Figure 3.3. The typical design defines the lane and shoulder width, and ensures drainage from the roadway surfaces to the median and side ditches for both cut and fill sections. The widths and thickness of the subgrade, subbase, base and asphalt layers are also specified in the typical cross-section design drawing.

The centrelines of each of the two eastbound and westbound lanes will be separated by a median of minimum 30 m width (measured between the centre lines of the two lanes in each direction, as shown in the typical section drawing in Figure 3.3) and up to 82.5 m. The median width along any section of the proposed TCH alignment has been determined by a combination of factors including topography and design standards, land uses, and various environmental considerations. The minimum median width is typically applied where constraints such as valuable agricultural and forest lands, wetland and other sensitive areas, and/or residential and commercial development are being avoided, or to limit the extent of disturbance in these areas. A wider median can offer more cost-effective design opportunities, and is therefore preferred.

3.2 Purpose, Rationale, and Need

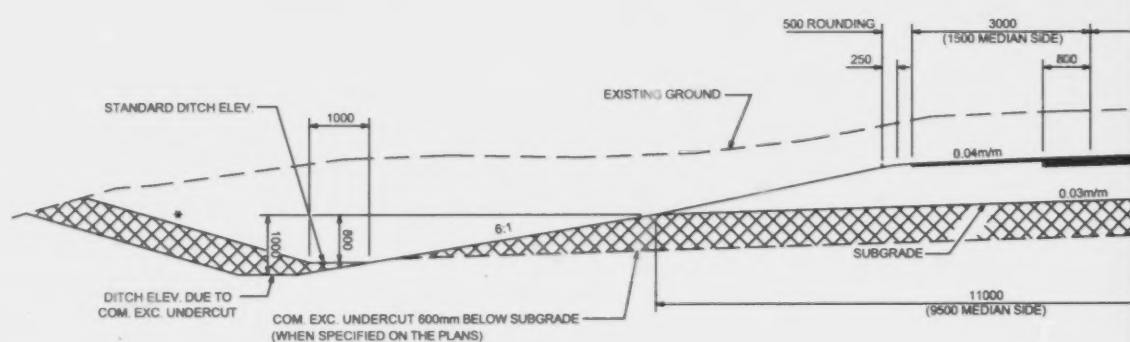
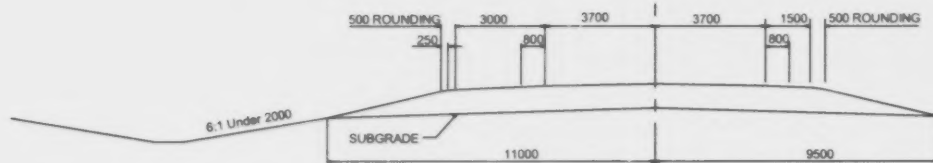
In the late 1980's the Province of New Brunswick set out its objective to upgrade the TCH, Route 2, from Nova Scotia to Quebec, to a four-lane access-controlled highway. Since that time the entire portion of the TCH from the Nova Scotia border to Fredericton, as well as other segments of Route 2 (e.g., Edmundston to Saint-Léonard and the Woodstock By-pass), have been upgraded to four lanes. Other segments of the TCH (e.g., Woodstock to Pokiok and Perth-Andover By-pass) are nearing completion. The portion of the TCH from Perth-Andover to Woodstock is the largest remaining segment to be upgraded to meet the Provincial objective.

The TCH through New Brunswick not only serves the transportation needs of New Brunswickers, but also provides the main east-west link between the Atlantic Provinces and the rest of Canada, and the link to the north-south Atlantic Canada - USA corridor. The segment of the TCH from Perth-Andover to Woodstock connects the northwest region of New Brunswick to southern parts of the Province, the other Atlantic Provinces, and the US Interstate Highway network.





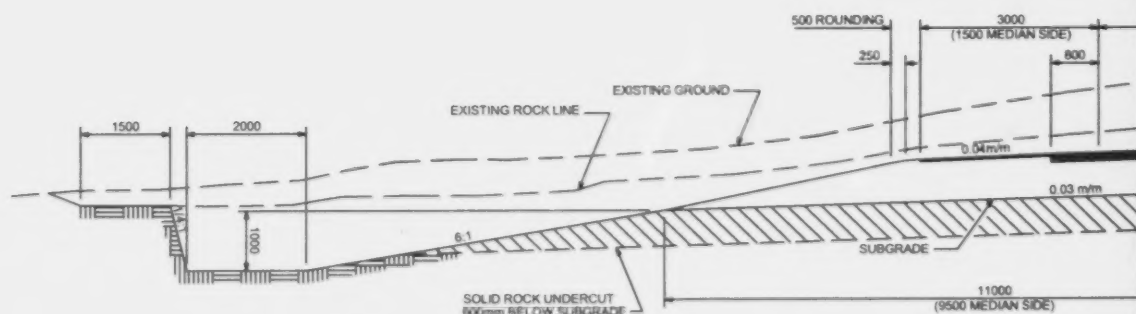
LANES



NOTE: * BACKSLOPE TYPICALLY 3:1

CE DITCH DEPTH AND WIDTH SHALL MATCH
SRE DITCH AT TRANSITIONS TO ROCK CUT

CUT SECTION - COMMON EXCAVATION (CE)



NOTE: * BACKSLOPE TYPICALLY 3:1

背背 3000 WHEN HEIGHT OF ROCK BACKSLOPE > 10m

CUT SECTION - SOLID ROCK EXCAVATION (SR)

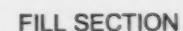
THE BASIC UNIT

REFERENCE DRAWING:
ADI LIMITED; DWG: 16100271_7

TYPICAL SECTION
NEW ROUTE 2 THROUGH
PERTH-ALBANY

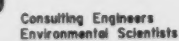
The diagram illustrates the cross-section of a road with two lanes. Key dimensions and features include:

- Overall Width:** 30,000 units.
- Lane Widths:** 3,700 units per lane.
- Shoulder Widths:** 1,500 units on the left and 1,500 units on the right.
- Subgrade Width:** 11,000 units.
- Grading Slopes:** 6:1 on the left and right sides.
- Ditch Width:** Varies, with a minimum of 800 units.
- Subgrade Slopes:** 6:1 Under 2,000; 4:1 2,000 to 5,000; 2:1 Over 5,000.
- Other Dimensions:** 9,500 units for the left shoulder, 3,000 units for the right shoulder, and 500 units for the rounding.



TYPICAL SECTIONS - FOUR LANE HIGHWAY
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Fig. No.: 3.3



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NBDOT traffic counts along the existing TCH from Perth-Andover to Woodstock indicate that it carries traffic volumes in the range of 4,200 to 8,800 vehicles per day. Trucks make up 27% to 34% of the total traffic stream within the Project limits.

Much of the traffic along this segment of the TCH is pass-by traffic (it originates and is destined outside of the Perth-Andover to Woodstock area). However, a considerable portion of the traffic mix between Perth-Andover and Woodstock is local, serving homes, businesses, and farms with driveway access that enters and exits directly into the traffic stream.

The existing TCH is typically hilly and winding with few passing opportunities. The existing traffic conditions, which includes heavy truck traffic, vehicles entering and exiting directly into the traffic stream, and infrequent passing opportunities, often lead to the accumulation of traffic into platoons. As a result, traffic often flows at less than posted speeds, which encourages risky passing manoeuvres by frustrated motorists. The fatality rate experienced along this segment of the TCH over the five year period from 1997 to 2001 was reported in the *2002 CSIF Program Prospective Analysis of Route 2 - Grand Falls to Longs Creek Project* report for NBDOT to be over twice that of the typical rate for National Highways in Canada.

The four-lane, divided, controlled access design of the proposed TCH will allow for high speed uninterrupted flow over the Project limits. All level crossing intersections will be grade separated, replaced with interchanges or eliminated. The proposed TCH will by-pass the existing two-lane facility from Perth-Andover to Woodstock and will divert all pass-by trucks and traveller traffic, and some of the local traffic, from the existing TCH. It will, therefore, enhance the safety of all motorists, including those remaining on the existing TCH, the scenic route.

The additional highway capacity and freer flowing traffic conditions offered by the proposed TCH will reduce travel time and costs of freight and passenger transportation through New Brunswick. This, in turn, will contribute to the fulfillment of the Province's long-standing objective to foster economic development growth.

3.3 Proposed Project Elements

Proposed Project elements include:

- the alignment of the main lanes (eastbound and westbound) from Perth-Andover to Woodstock;
- interchanges and new connector roads;
- grade separations;
- secondary road modifications;



- stream crossings (*i.e.*, bridges and culverts); and
- property access roads.

These are shown in Figure 3.2 A-D (Appendix C), and described in detail below.

3.3.1 Proposed TCH Alignment

Following Figures 3.2 A-D (Appendix C) north to south, the proposed TCH will begin in Perth-Andover south of the Route 190 Interchange of the Perth-Andover By-Pass, and will terminate at the Route 550 Interchange in Woodstock. The proposed TCH is aligned more directly north-south, not following the Saint John River, and, as a result, measures a distance of 70.7 km versus the 76.2 km of the existing TCH that essentially parallels the Saint John River.

As described in section 2.2, the proposed alignment was selected in consultation with the various stakeholders including local property owners and regulatory agencies with care to avoid agricultural lands, or to locate the alignment at the back end of properties or in less (agricultural) valuable areas. Other environmentally sensitive areas, such as wetland areas, moose areas, and the rare plant communities (Figure 2.1 A-D, Appendix B) were avoided to the extent possible.

3.3.2 Interchanges

Access to the proposed TCH will be limited to four Route 2 (*i.e.*, existing TCH) interchanges as presented in Figures 3.2 A-D (Appendix C) and described below. There will be no at-grade intersections with minor roads, private driveways or property access roads permitted anywhere along the proposed TCH.

The proposed Route 110 Interchange at Florenceville, located approximately 2 km west of Route 103 in Florenceville, will be constructed to a full diamond design configuration (Figure 3.2 C, Appendix C).

The Hartland Interchange will be constructed to a full diamond design and will be located less than 2 km west of the existing TCH at Somerville (Figure 3.2 D, Appendix C). A new 1.8 km connector road will be constructed from the proposed TCH to the existing TCH.

Design of the Lockhart Mill Road Interchange (Jacksonville) is a half parclo - button-hook interchange configuration. The eastbound lanes will be served by the parclo ramps, and will intersect with the Lockhart Mill Road. The westbound lanes will be served by the button hook ramps that will connect to Route 560 on the east side of the proposed TCH (Figure 3.2 D, Appendix C). An environmental screening of this interchange has been previously undertaken and approved. Work is already underway to construct the four-lane structure and the interchange ramps to serve the existing two-lane TCH at this location. The



upgrade to the final four-lane TCH configuration for this Project will require minor modifications to the interchange ramps.

Route 550 Interchange (Connell Road, Woodstock) will be a full diamond four-lane interchange of the proposed TCH, and will involve the upgrade of the existing two-lane diamond interchange (Figure 3.2 D, Appendix C). A parallel structure and reconfigured ramps will be constructed.

The Perth-Andover By-Pass Project (Route 190 Interchange) presently under construction, will require modification to the existing TCH and construction of a new 1.0 km connector road from the modified TCH to the Perth-Andover Bridge (Figure 3.2 A, Appendix C). These will be done as part of this Project and will be constructed to typical RCU 80 (Rural Collector Undivided highway with design of 80 kph) standards. Figure 3.4 depicts a typical cross-section for these connector roads and modified secondary roads.

3.3.3 Grade Separations

In addition to the four interchanges described above, grade separations (overpasses and underpasses) of the proposed TCH over and under secondary roads will be constructed at 13 locations along the proposed alignment. Grade separation structures will allow traffic on secondary roads continued passage across the proposed TCH, but will not provide access to it. One or two structures, depending on the configuration and the width of the median, will be constructed at each of the following locations (Figures 3.2 A-D, Appendix C):

- Beaconsfield Road - TCH overpass;
- Scott Road - TCH underpass;
- Dean Road - TCH overpass;
- Route 560 (north at River de Chute) - TCH overpass;
- Stairs Road - TCH underpass;
- B. Smith Road - TCH underpass;
- Backland Road - TCH underpass;
- Sipprell Road - TCH underpass;
- Dryer Road - TCH overpass;
- Raymond Road - TCH underpass;
- Estey Road - TCH underpass;
- Palmer Road - TCH underpass; and
- Route 560 (south at Jacksonville) - TCH overpass.



3.3.4 Secondary Road Modifications

As a result of the interchanges and grade separations, modifications will be required to realign several of the existing secondary roads to line up to the proposed TCH structures. The following six secondary roads will require modification in the vicinity of the proposed TCH (Figures 3.2 A-D, Appendix C):

- Scott Road;
- Stairs Road;
- Backland Road;
- Sipprell Road;
- Dryer Road; and
- Raymond Road.

3.3.5 Bridges and Stream Crossings

Three bridge crossings will be constructed along the proposed TCH. They include bridges over River de Chute, Big Presque Isle Stream, and Little Presque Isle Stream (Figures 3.2 B-D, Appendix C). In addition, a two-lane bridge will be constructed over the Little Presque Isle Stream, as part of the new connector road between the new Hartland Interchange and the existing TCH at Somerville (Figure 3.2 D, Appendix C).

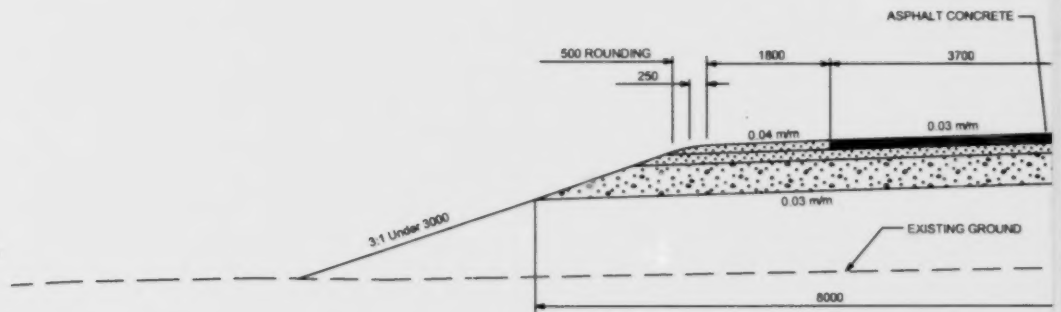
There will be 43 minor watercourse crossings that do not require bridges. Culverts of various size and configuration will be installed at each of these locations. See Section 5.3 (Surface Water) for additional information related to culvert sizing.

3.3.6 Property Access Roads

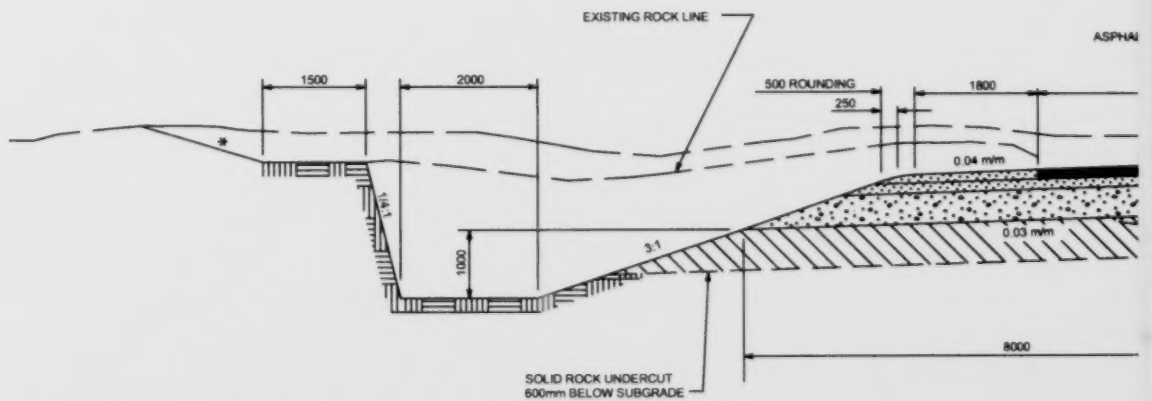
Property access roads will be constructed to provide continued access to properties that have been severed or cut off from their existing access by the proposed TCH. Figure 3.5 presents the three typical standards of property access roads constructed by NBDOT to retain access to private properties.



F



FILL



SOLID ROCK EXCAVATION (SRE)

NOTE: DITCH WIDTH TO BE 3000 WHEN DEPTH OF
SOLID ROCK CUT IS GREATER THAN 10 metres.

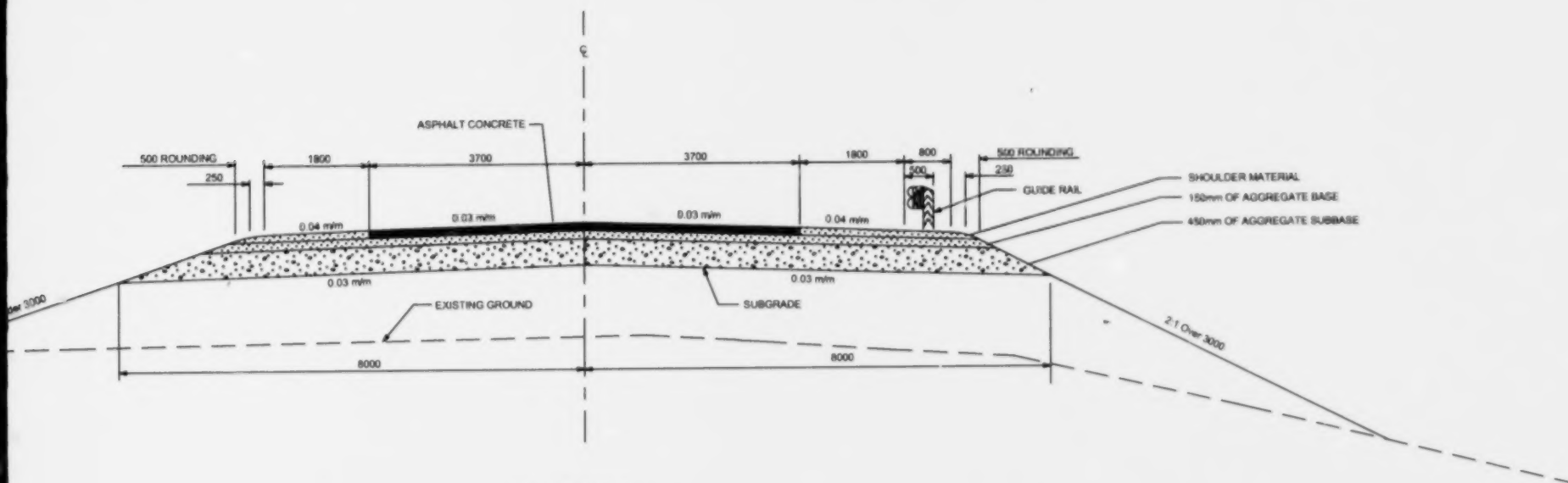
THE BASIC UNIT

REFERENCE DRAWING:
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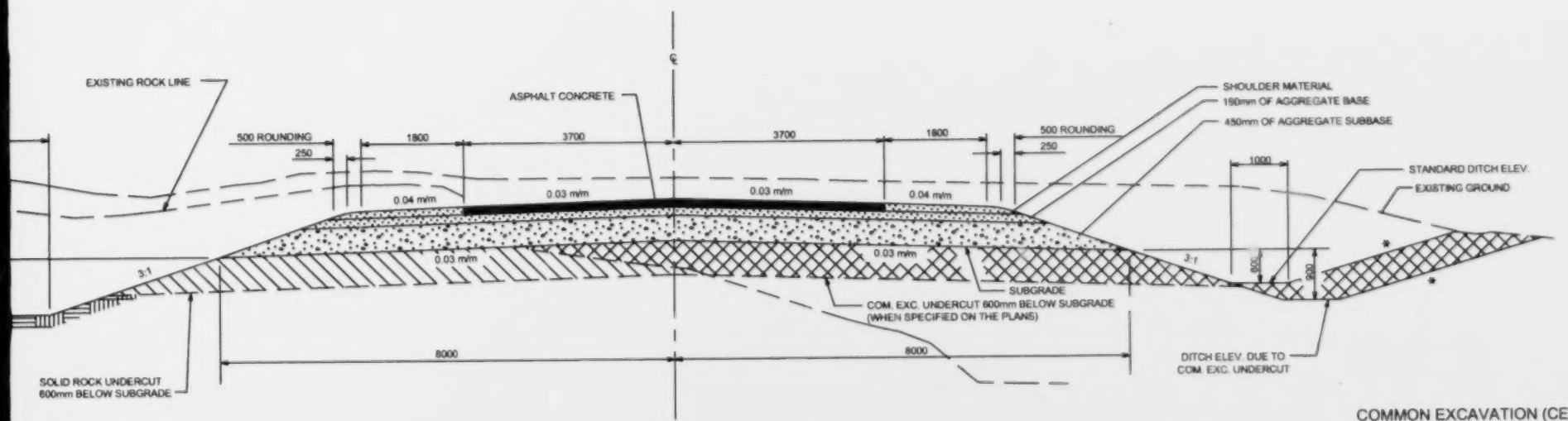
TYPICAL SECTION
NEW ROUTE 2 TR
PERTH-A

FILE: 14677\WORKING\JW-16100271_7

RCU 80



FILL SECTION



CUT SECTION

COMMON EXCAVATION (CE)

NOTE: * SLOPE TYPICALLY 3:1

THE BASIC UNIT OF DIMENSIONING IS MILLIMETRES

TYPICAL SECTIONS CONNECTOR ROADS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:
2003 10 03

Job No.:
14677

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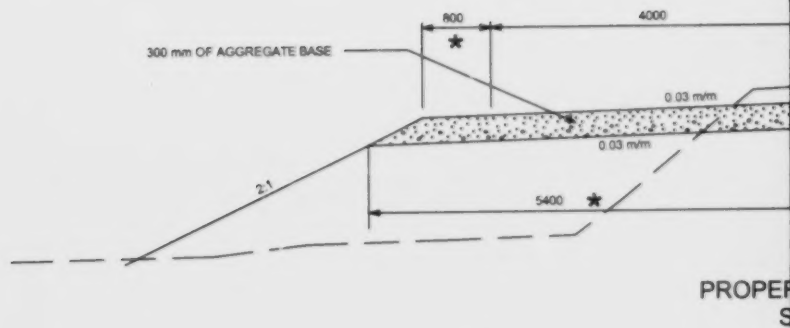
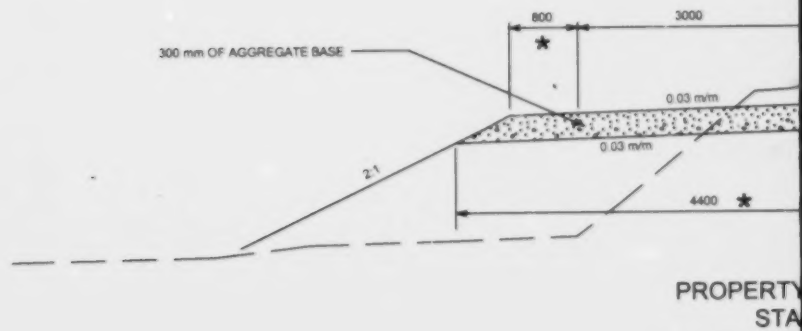
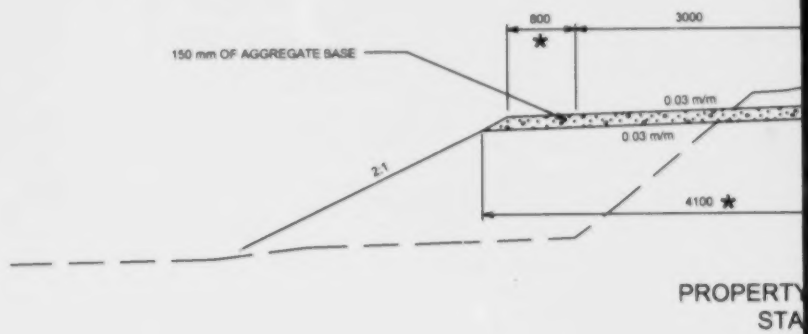
Fig. No.:
3.4



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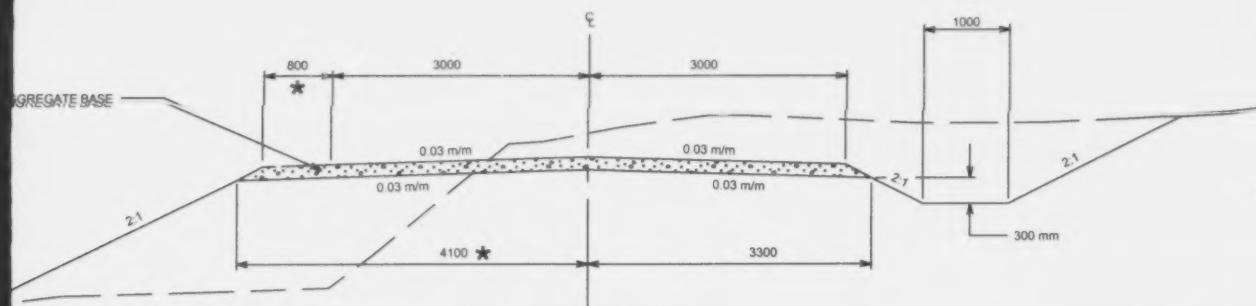
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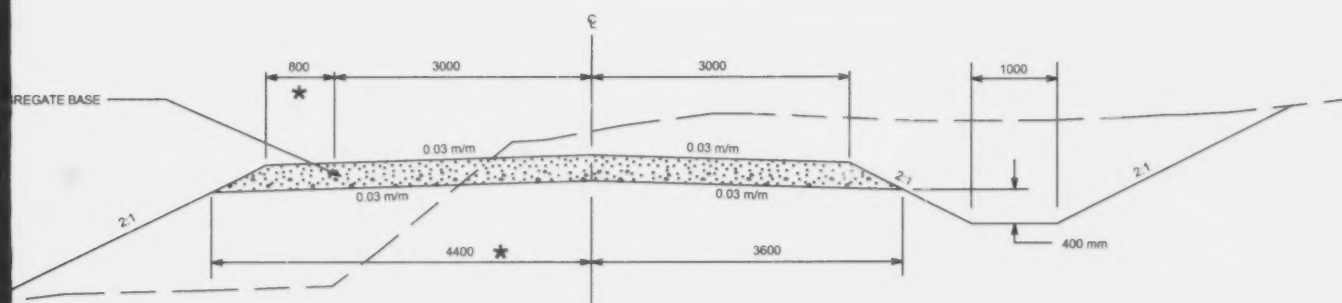
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REFERENCE DRAWING:
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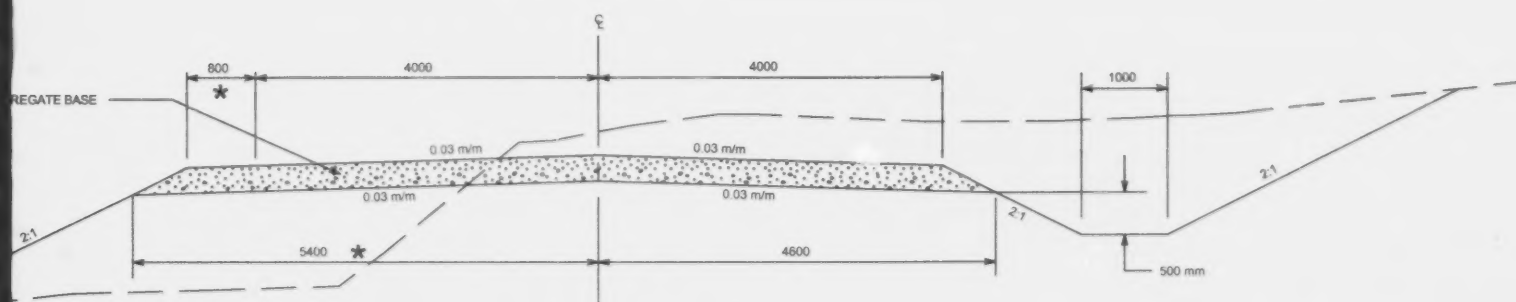
TYPICAL SECTION
NEW ROUTE 2 TR
PERTH-A



PROPERTY ACCESS ROAD
STANDARD #1



PROPERTY ACCESS ROAD
STANDARD #2



PROPERTY ACCESS ROAD
STANDARD #3

THE BASIC UNIT OF DIMENSIONING IS MILLIMETRES

NOTES: 1 BACKSLOPES IN SOLID ROCK CUTS ARE 1/4:1 WITH A 1000 mm BENCH AND THEN A 2:1 BACKSLOPE IN COM. EXC.

2 * EXTRA 800mm WIDTH WHERE GUIDE RAIL IS REQUIRED IN FILLS OVER 3 m.

TYPICAL SECTIONS PROPERTY ACCESS ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:
2003 10 03

Job No.:
14677

Scale:
N.T.S.

Fig. No.:
3.5



Jacques Whitford

Consulting Engineers
Environmental Scientists

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The Project will require the construction of 18 property access roads. The following list of property access roads provides the planned standard level and lengths. Property Access Road Standard Levels are chosen according to the expected level and use of the road. They are referenced in Figures 3.2 A-D (Appendix C) by assigned letters below.

- Access Road A: Level 2, 2200 m south at Perth-Andover, west of proposed TCH;
- Access Road B: Level 3, 3391 m south from Beaconsfield Road, west of proposed TCH;
- Access Road C: Level 1, 78 m north from Beaconsfield Road, west of proposed TCH;
- Access Road D: Level 1, 667 m east turning north from Scott Road, west of proposed TCH;
- Access Road E: Level 1, 352 m south from Access Road "F", west of proposed TCH;
- Access Road F: Level 3, 1463 m east turning north from Browning Road, west of proposed TCH;
- Access Road G: Level 1, 191 m north from Brown Road, east of proposed TCH;
- Access Road H: Level 1, 145 m east from Back Greenfield Road, west of proposed TCH;
- Access Road J: Level 3, 2252 m south from Upton Road, west of proposed TCH;
- Access Road K: Level 3, 2398 m north from Dryer Road, east of proposed TCH;
- Access Road L: Level 1, 182 m north from Sprague Road, west of proposed TCH;
- Access Road M: Level 1, 838 m north from Raymond Road, east of proposed TCH;
- Access Road N: Level 1, approximately 150 m north from Hartland Interchange Connector Road, east of proposed TCH;
- Access Road O: Level 1, approximately 180 m south from Hartland Interchange Connector Road, west of proposed TCH;
- Access Road P: Level 1, 324 m north from Palmer Road, east of proposed TCH;
- Access Road Q: Level 1, 214 m south from Palmer Road, east of proposed TCH;
- Access Road R: Level 1, 650 m south from Lockhart Mill Road, west of proposed TCH; and
- Access Road S: Level 1, 629 m south from Route 560 near Lockhart Mill Road Interchange, west of the proposed TCH.

3.3.7 Other Proposed Project Elements

Presently, NBDOT has no plans to construct rest areas or weigh stations within the Project limits. Preliminary conceptual plans for an ARWIS (Advanced Roadway Weather Information System) network for the TCH through New Brunswick are presently under consideration. Although there is no commitment to the system at this time, if implemented, there may be one or two installations within the Project limits. The ARWIS installations would be located roadside, within the proposed footprint, so there will be no need to extend the proposed RoW to accommodate this system.

Although concerted efforts were made to select an alignment that would avoid deer and moose habitat, the proposed TCH will pass through, and/or run alongside ungulate habitat areas. NBDOT and the NBDNR



are investigating the possibilities and potential locations of deer/moose fencing and/or wildlife crossings along the proposed alignment. These installations would, however, be located within the proposed RoW.

Other ancillary facilities required to construct the proposed TCH include material storage areas, temporary access roads, gravel pits and aggregate quarries, and asphalt plants. The locations of these ancillary facilities will be identified as part of the developers' bid proposals, and have not as yet been established. The locations and operations of these facilities will be subject to the approval of NBDOT, the Department of Environment and Local Government (NBDELG), and all applicable regulations (*i.e.*, *Watercourse and Wetland Alteration Regulation*, *Air Quality Regulation*) and guidelines (*i.e.*, *Draft Guidelines for Pits and Quarries*, NBDELG 2000).

3.4 Project Activities

3.4.1 Construction Activities

The following is a description of construction activities typical for controlled-access highway construction projects of this nature in New Brunswick. The description of construction activities has been divided into five categories:

- **Site Preparation** includes activities associated with preparing the site for road and structure development (including access roads and interchanges) such as surveying, clearing, and removal of obstructions;
- **Roadbed Preparation** includes the activities associated with construction of the roadbed (including access roads and structures) such as blasting, cuts and fills, and drainage culverts;
- **Watercourse Crossing Structures** includes installation of culverts and bridges;
- **Surfacing and Finishing** which includes activities such as paving, line painting, and installation of signs, guide rails and wildlife crossings and fencing; and
- **Ancillary Structures and Facilities** includes development of temporary site access roads, borrow areas, storage areas, disposal sites, and asphalt plants.

3.4.1.1 Site Preparation

3.4.1.1.1 Surveying and Geotechnical Investigations

Surveying includes the cutting of a centreline for each lane and cross-section offsets, wide enough to provide unobstructed sight lines as well as to allow access along the RoW for vehicles and/or geotechnical equipment. Clearing for surveying activities will take place outside of the breeding season for birds (*i.e.*, no clearing between May 1st and August 31st). The survey crew will carry out their garbage, retain access



roads unobstructed, maintain ascribed tree cutting and felling and removal practices and take all the necessary precautions to prevent pollution or obstruction of watercourses.

Geotechnical investigations involve the drilling of boreholes or excavation of test pits along the centreline and offsets to determine the subsurface conditions. This may require some further clearing. Equipment used includes a backhoe or drill rig with tracks.

Access across watercourses and wetlands during these activities will be conducted in accordance with applicable permits (e.g., Watercourse Alteration Permit) and/or applicable regulations (i.e., *Watercourse and Wetland Alteration Regulation*) and guidelines (i.e., *Watercourse Alteration Technical Guidelines*). Appropriate environmental protection procedures for these activities are included in Sections 3.2.2 and 3.2.3, respectively, of NBDOT's Environmental Protection Plan (EPP) (NBDOT 1998a). Section 4.7 of NBDOT's Environmental Field Guide (EFG) (Washburn & Gillis 1998) provides environmental protection measures for temporary watercourse crossings.

3.4.1.1.2 Clearing and Grubbing

The limits of clearing are flagged prior to/in advance of clearing activity (i.e., during surveying) to limit the amount of clearing to that which is required for construction of the main lanes (including interchanges and structures), secondary and connector roads, and property access roads. The clearing width for the main lanes will vary depending on the toe of slope of the embankments. Merchantable timber remaining on private lands is harvested and sold to mills, while that remaining on Crown land under license goes to the licensee. Landowners may harvest the merchantable timber from lands being acquired by NBDOT prior to or as a condition of their sale. Harvesting would be conducted using conventional harvesting techniques and equipment typically used in New Brunswick, with NBDOT developers following guidelines set out in the Section 4.1 of the EPP.

The NBDOT Standard Specifications (NBDOT 2003) outline procedures for clearing. Trees will be cut to within 0.5 m of the ground. Merchantable timber (minimum top diameter of 80 mm and a length of 2.44 m) will be delimbed and removed from the site, while non-salvageable material will be chipped, burned or shredded within the RoW and left in place.

The primary environmental concern during clearing is to minimize ground disturbance that may result in the erosion and sedimentation of wetlands and watercourses. Clearing activities will take place outside of the breeding season for birds (i.e., no clearing between May 1st and August 31st) and, when possible, clearing operations will be conducted during winter months as frozen ground provides the necessary bearing capacity for heavy machinery, protecting the underlying vegetative mat and minimizing the potential for erosion and sedimentation. Working on frozen ground makes the work site more accessible, reduces the cost of access road development, and increases the speed at which skid trails can be used.



Hand clearing will be conducted where ground conditions are not suitable for access by heavy equipment, such as near watercourses.

Grubbing for roadway construction involves the removal of all organic material and unsuitable soil above the underlying soil. It also consists of the removal and disposal of all stumps, roots, downed timber, embedded logs, humus, root mat and topsoil from areas of excavations and embankments or other areas as directed by the Resident Engineer. All areas where fills are less than 2.5 m or where excavation is planned, must be grubbed. Grubbing is usually not required under fills greater than 2.5 m in depth, unless a structure (bridge, culvert or retaining wall) is to be constructed, or where a significant layer of compressible soil exists that could cause a future settlement problem. To minimize environmental risks associated with erosion and sedimentation, a 30 m buffer of undisturbed vegetation will be maintained between the construction area and watercourses until culverts are installed and required erosion and sediment controls (e.g., sediment fence, settlement ponds) are in place.

Bulldozers are typically used to scrape the organic material off the underlying soil and to pile the material. If the grubbed material is to be removed from the site, track-mounted excavators are sometimes used to load the material on to dump trucks. Where grubbing involves the removal of extensive organic deposits (i.e., peat), the material is usually removed by an excavator and loaded directly to dump trucks. If the unsuitable material cannot be removed with a track-mounted excavator, a drag-line excavator can be used.

Topsoil will be salvaged for use in medians and on side slopes as per NBDOT (2003) Standard Specifications (Item 613). Other grubbed material will be disposed of in accordance with Section 4.18 of the EPP.

3.4.1.1.3 Modification, Relocation, or Removal of Existing Structures

Following and/or during clearing and grubbing activities, removal, relocation, or modification of existing structures (e.g., buildings, wells) will be undertaken as required to prepare the RoW for grading. Modification, relocation, or removal of structures will be conducted in accordance with landowner agreements and all applicable regulations, standards, and guidelines. Disposal of construction and demolition waste will be conducted in accordance with NBDOT Standard Specifications (2003), the EPP, the *Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site* (NBDELG 2002a), and any provisions included in site specific contracts. There are approximately 30 residences, 1 apartment building, 1 church parsonage, 2 commercial establishments, and 1 home business that will be removed or relocated.



3.4.1.2 Roadbed Preparation

3.4.1.2.1 Subgrade

Following grubbing, the subgrade will be accomplished by cutting the high areas and using the material to fill in the low areas to provide an appropriate vertical alignment. Subgrade is the soil upon which the road is built, providing strength and stability. It may be undisturbed or it may require modification. If the existing grade is a specified cut location then the soil is excavated to the specified subgrade elevation. If the exposed subgrade is of suitable material, then it is compacted until firm and stable. If the exposed subgrade consists of unsuitable material (e.g., organics), then the unsuitable material is excavated and replaced in specified lift thicknesses with suitable material to the specified subgrade elevation. Each lift is compacted to the specified moisture and density. Similarly, in specified fill locations, the subgrade is constructed by placing acceptable fill, either from cuts or borrow sources, spreading it in layers of specified thickness and, using moisture control procedures, compacting each lift to a specified density. Subsequent layers are added until the desired elevation is reached, and the subgrade is firm and stable.

The vertical alignment of a highway consists of straight grades, and crest (hill tops) and sag (valleys) vertical curves. The limiting design criteria for vertical curves are based on user comfort and safety. The design of vertical curves must also consider provision of adequate stopping sight distance and headlight visibility. Changes in vertical alignment involving cut and fills are also required on the approaches to highway overpasses or underpasses of other roads, and watercourses. Cuts and fills will be accomplished using earth moving machinery such as bulldozers, excavators, graders, loaders and articulated haulers. Compaction is accomplished using rollers, soil compactors or both.

3.4.1.2.2 Excavation, Blasting and Ripping

The removal of material for the construction of subgrade may involve one or more methods of excavation including common excavation, rock excavation, and unclassified excavation. Common excavation is the removal of overburden, including till, smaller boulders, and topsoil. Rock excavation is the excavation of rock that is considered to be bedrock or single pieces greater than one cubic metre in size. Cuts in "soft" rock can be accomplished using ripper blades attached to the back of larger bulldozers, breaking up the rock so that it can be loaded on to dump trucks with an excavator or loader. This procedure tends to be successful in softer rock such as shales and sandstones, and in areas where the bedrock surface is highly weathered and/or fractured.

Excavated soils unsuitable for use as fill or dressing slopes are disposed of at a site approved by the Resident Engineer and in accordance with Section 4.18 of the EPP.



The use of blasting for rock excavation is dependent upon the competency of the rock. The developer will determine whether or not blasting will be required for the construction of the proposed TCH. Wherever possible, rock excavation will typically be performed by ripping rather than blasting, due to the lower costs involved.

If blasting is deemed to be necessary, blasting operations will be conducted in accordance with Section 4.4 of the EPP and all applicable regulations and guidelines. Blasting operations are governed by provincial regulations throughout New Brunswick. Blasting in or near watercourses will require approval from Fisheries and Oceans Canada, and shall be conducted in accordance with the *Guidelines for Use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky 1998). Blasting shall also be conducted in accordance with the applicable laws, regulations, orders of the Workplace Health, Safety and Compensation Commission of New Brunswick, NBDNR, Natural Resources Canada, and the New Brunswick *Transportation of Dangerous Goods Act*. The developer performing the blasting will have a valid license and will ensure that a pre-blast survey of any nearby wells and structures (*i.e.*, within 500 m) has been conducted prior to blasting.

Where feasible, as determined by suitability of the material and hauling costs, material excavated from the RoW is used for fill. If the excavated material is determined to be unacceptable for use as road building material, materials will be obtained from nearby approved borrow sources. Borrow pits will be developed outside of, but in close proximity to, the RoW. Borrow material will be free of contaminants and must be approved for suitability for the Project prior to use. Borrow pits will be located away from areas suspected as having potential for sulfide bearing rocks or aggregate resources. Erosion control measures will be employed at these sites, where required, to prevent siltation of watercourses and wetlands. Section 4.9 of the EPP and the *Draft Guidelines for Pits and Quarries* (NBDELG 2000) will be followed.

Cut and fill volumes, found in Table 3.4.1, are divided into five stretches of the Route 2, Perth-Andover to Woodstock highway which represent the way in which the design engineers have divided up the proposed work. The cut and fill sources of these volumes are shown on four maps (Figure 3.6-A to 3.6-D). The estimated values indicate an overall surplus volume of 7,448,827 m³ of excavated material. It should be noted that estimated cut and fill volumes are based on grade levels, may contain overburden in addition to bedrock, and consider the excavation of the entire purchased RoW which in many cases will not be required. Also, cuts were assumed to be all common excavation with 3:1 backslopes, which exaggerate quantities. As a result, values in the table are conservative estimates. These estimated quantities will be significantly reduced when the rock line is defined. A reasonable quantity balance should be achievable on all sections.

In the case of the Wark Brook to Scott Road Section imbalance, hilly terrain requires substantially larger cuts and fills than the other sections. Minor changes in grade in this section will significantly affect cut



and fill quantities. For example, during a preliminary cut and fill balance exercise, raising the grade a couple metres resulted in 500,000 m³ change in quantity balance.

Table 3.4.1 Cut and Fill Volumes: Route 2, Perth-Andover to Woodstock

	Cut (m3)	Fill (m3)	Surplus/Deficit
Wark Brook to Scott Road (Fenco)	8,927,909	2,606,064	+6,321,845
Scott Road to J. Clark Road (Hillside)	2,140,522	1,462,553	+677,969
J. Clark Road to Route 110 (N & G)	1,632,256	1,278,104	+354,152
Route 110 to Hartland Interchange (Comtrac)	1,347,039	984,063	+362,976
Hartland Interchange to Route 560 (Geoplan)	1,819,474	2,087,589	-268,115
Totals	15,867,200	8,418,373	+7,448,827

During the design and construction phase of the project, an ongoing effort will be made to balance the cut and fill volumes. In particular, attention to balancing measures will be taken in areas where potential acid or sulfide-bearing rock is located. Balancing the cut and fill can be achieved by altering the grade and making slight alignment adjustments within the RoW.

Excavated material will be stored, or used as fill, as much as possible within the RoW. Material will also be used for dressing slopes created by the grade cuts. Materials unsuitable for such uses will be disposed of within the RoW at a site approved by the Resident Engineer and in accordance with Section 4.18 of the EPP, or outside the RoW as per Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site. Transportation required for the cut and fill process has not yet been determined. Due to issues such as compaction and final grade requirements, the amount of transportation required to dispose and/or utilize excess material cannot be determined. However, the transportation of material will be self-regulated, as it will be in the developer's best interest to minimize costs to transport this material.

Where sulfide bearing rock is identified, excavation will be avoided or minimized by adjusting the alignment horizontally (within the RoW) and/or vertically where possible. If acid rock were identified during the construction phase, NBDOT's Acid Rock Committee will be immediately contacted and site-specific protection measures will be implemented as identified in section 7.11 of the EPP, section 4.8.2 of the EFG and/or as recommended by the Committee. Environment Canada will also be contacted for advice. The extent and quantity of acid rock will be determined through testing and the necessary mitigation will be developed. If the material cannot be avoided, its excavation and disposal are subject to a pre-approved plan by the Acid Rock Committee. The material may be disposed of either within the RoW or an approved area located off-site. Should marine environment disposal of sulfide bearing rock be required (which is very unlikely) the private developer will obtain a Disposal At Sea Permit.



3.4.1.2.3 Subbase and Base Construction

Once the subgrade has been prepared, a granular graded structural base known as the subbase and base course is prepared. The subbase gravel is placed over the subgrade and generally consists of material superior in quality to that used for the subgrade. The base course is placed over the subbase and consists of a series of layers, graded to provide structural integrity and good drainage beneath the asphalt concrete surface. The materials used to construct the subbase and base are typically obtained from borrow areas as previously described.

3.4.1.2.4 Structures (Overpasses/Underpasses)

Construction of structures (*e.g.*, overpasses, underpasses) will begin with the installation of properly designed erosion and sediment control measures followed by clearing and grubbing, excavation, and embankment fills as required. The foundations for abutments and piers will typically be cast-in-place reinforced concrete on either spread footings or piles. The prefabricated girders, either of pre-stressed concrete or steel construction, are then put into place using cranes. The deck is constructed of cast-in-place reinforced concrete, a waterproofing membrane is then applied and the surface is paved to match the design grade of the road surface at that point.

3.4.1.2.5 Work Progression

The progression of construction activities, as described in the NBDOT (2003) Standard Specifications and Section 4.16 of the EPP, will be carried out in a manner such that work in any work area proceeds continuously and diligently so as to ensure an orderly progression of work and effective protection of the environment. The Work Progression Clause (Item 946.2.1, NBDOT (2003) Standard Specifications) states that grade work must be completed within 30 days in a given work area. That work area would then be temporarily stabilized, and left alone for an extended period (up to a year) until the developer returns to pave the area, and provide final stabilization. In any given work area, the time between grubbing/cut/fill constructions to completion and stabilization of excavations must be no greater than 30 days. Exposed soils near watercourses will require immediate temporary stabilization measures as per Sections 948.1.1, 948.1.2, 948.2.1.5, and 948.2.1.9 of the NBDOT (2003) Standard Specifications, and will require contingency measures for rain events. Stabilization refers to hydroseeding and/or mulching, and includes completion of ditches and shaping of slopes as well as installation and maintenance of erosion and sediment control structures.



3.4.1.3 Watercourse Crossing Structures

There are 47 watercourse crossings for the Project limits. Most of the watercourse crossings will be accomplished using culverts, with the exception of the bridge structures to be constructed at River de Chute, Big Presque Isle Stream, and Little Presque Isle Stream. In addition, a two-lane bridge will be constructed over the Little Presque Isle Stream, as part of the new connector road between the new Hartland Interchange and existing TCH at Somerville. Excavation for foundations in a watercourse will be conducted in a manner that minimizes siltation. This will require the use of cofferdams, silt screens, special pumping procedures, special excavation equipment, watertight barges, and watertight trucks. Excavation is normally not permitted in the flowing stream. A Watercourse Alteration Permit and a *Navigable Waters Protection Act Permit* are required prior to commencement of any bridge construction activity. Bridge construction will be conducted in accordance with these permits, NBDOT (2003) Standard Specifications, Section 5.4 of the EPP, and Section 7.0 of the EFG.

The remaining 43 crossings will be constructed using culverts. They include Harper Brook, Hunters Brook, Whitemarsh Creek, Lower Guisguet Brook, Gallop Brook, Graham Brook, Brown Brook, Bryson Brook, Demerchant Brook, Plant Brook, Ward Brook, Tibbetts Brook, and a number of unnamed streams.

Culvert installations at watercourse crossings are normally accomplished by constructing temporary stream diversions, allowing the culvert to be bedded "in the dry" and backfilled prior to conveying the stream through the culvert. All instream work will be conducted during low-flow periods (June 1 - September 30) to avoid interference with fish spawning, incubation and hatching activities, where possible. Applicable erosion and sediment control practices as outlined in the EPP (Section 4.3 to 4.7) and the EFG (Section 4.2 and 6.0) will be adhered to during this process. Culverts requiring fish passage will be designed so as not to interfere with use of the stream by fish. A Watercourse Alteration Permit will be required prior to any construction activities within 30 m of a watercourse. Where it is determined that there will be harmful alteration, disruption or destruction of fish habitat, an authorization pursuant to Section 35 (2) of the Fisheries Act would be obtained from DFO.

Ditching, side slopes, and drainage channels are designed and constructed to avoid erosion problems and ponding over and along roadways from surface water runoff. Ditches, culverts, and drainage channels are constructed where natural drainage and surface runoff flows are disrupted by the new roadway. Drainage channels are directed away from natural watercourses and into surrounding vegetation. Erosion control structures, mulching or hydroseeding, and/or the use of riprap are measures applied to ditches, side slopes, and channels in an effort to minimize or prevent siltation of watercourses or wetlands and prevent erosion.

All watercourse crossings are designed to accommodate the precipitation levels of a one in 100 year peak discharge event for the local region as defined by data from the Meteorological Service of Canada.



An active re-vegetation program will be implemented after construction using site-appropriate methods to maximize soil support. Re-vegetation of all disturbed/exposed areas will be undertaken. All ditches and side slopes will be stabilized not only by technical means, but also by applying a mixture of grass seed and mulch, as specified in Section 4.8 of the EPP and in accordance with the NBDOT (2003) Standard Specifications.

3.4.1.4 Surfacing and Finishing

Paving

Conventional asphalt concrete has been used for nearly all provincial highways in New Brunswick in the past and will be used in the construction of this proposed section of the TCH. It will also be applied to all new and modified collector and local roads of the Project. This material is made by mixing petroleum based liquid asphalt with sand and crushed stone in an asphalt plant. The hot mix is easily transported, spread and rolled to provide a smooth surface that can be used almost immediately. Note that property access roads, constructed as part of the Project, will not be paved.

Appropriate erosion control measures will be employed during paving operations to minimize runoff from the construction site, where warranted. Paving will be conducted in accordance with NBDOT (2003) Standard Specifications and Section 4.15 of the EPP.

Signage and Guiderails

Signage and guiderails will be installed once most construction activities have been completed. Signage installation involves very localized disturbances within the finished RoW, and will require small amounts of excavation and poured concrete footings for the erection of the signposts and signs. Guiderail installation involves posthole drilling, post installation and attachment of metal guiderails to the posts. Environmental protection procedures for signage and guide rail installation are included in the Section 6.1.9 of the EPP.

Painting

The painting of pavement markings (or striping) will also be performed after most construction activities have been completed. Striping a highway consists of painting yellow and white longitudinal and transverse lines and other symbols and words as required on road surfaces to ensure the travelling public receives direction and guidance. The arrangement of these markings will be in accordance with TAC's *Manual of Uniform Traffic Control Devices* (TAC 1998) and NBDOT policies. In New Brunswick, NBDOT stripes approximately 13,000 kms of road annually using 560,000 litres of paint. This program is achieved mostly with the use of two 3 ton striping vehicles and a smaller towed paint unit called the



"Road Laser". The paint applied down by these vehicles is known as "Hot Applied Alkyd Traffic Paint". As the paint is applied on the highway, a layer of spherical glass beads is sprayed on top. These beads render the paint reflective thus improving the safety of night time driving. Environmental protection procedures for painting are included in the EPP (Section 6.1.14).

Wildlife Crossings

Wildlife crossings/underpasses and fencing will be constructed in consultation with NBDNR to minimize potential environmental effects of habitat fragmentation and wildlife mortality (road kill), as well as increase safety to the travelling public. The design and construction of these structures will coincide with planned culvert/bridge crossings and will draw upon experience and observation of the effectiveness of established wildlife crossings on existing highways in New Brunswick.

3.4.1.5 Ancillary Structures and Facilities

Temporary Access Roads

The activities described above will require provision of access to and along the RoW. Existing logging roads and access roads will be used to the extent possible; however, temporary access roads may be necessary. Temporary access roads will be constructed in accordance with landowner agreements.

Borrow Areas

As previously indicated, borrow pits will be developed outside of, but in close proximity to, the RoW. Borrow material will be free of contaminants and must be approved for suitability for the Project prior to use. Borrow pits will be located away from areas suspected as having potential for acid-generating rocks or aggregate. Erosion control measures will be employed at these sites, where required, to prevent siltation of watercourses and wetlands. Section 4.9 of the EPP and the *Draft Guidelines for Pits and Quarries* (NBDELG 2000) will be followed.

Petroleum Storage Areas

Sites for machinery and fuel storage will be selected by the developer. The site will be selected in accordance with the EPP, particularly as they relate to the potential risk of accidental release of petroleum, oils and lubricants (EPP Sections 4.17, 4.19 and 8.1). During fuelling and maintenance of construction equipment, proper environmental protection control measures to prevent the release of fuels to the environment will be taken. Spills will be handled in accordance with environmental contingency plan (EPP Sections 4.19 and 8.1, and EFG Sections 5.5 and 5.7). The developer will be responsible for



obtaining the appropriate permits as set out in the Petroleum Product Storage and Handling Regulations for any on-site temporary fuel storage tanks.

Materials and Equipment Transportation

Vehicles used in subgrade construction typically include excavators, bulldozers, rollers, trucks, and graders. Most of these vehicles operate on diesel fuel and require some form of daily maintenance. Truck traffic generated by the Project on the existing highway network during subgrade construction is largely dependent upon the amount of imported fill material required. It is expected that most, if not all, of the subgrade fill material will be available from the excavation operations within the RoW. Off-site truck traffic will consist primarily of hauling various materials to approved disposal sites, and/or the movement of construction equipment to and from the Project site. Therefore, trucking operations during the subgrade construction phase will mainly involve on-site transportation activities of materials for cut and fill operations.

Off-site truck traffic will be generated during the construction of the proposed TCH subbase and base layers. The volume of truck traffic will depend upon the quantities of crushed stone aggregates and other borrow materials that need to be imported to the site versus that which can be produced on-site from cut sections along the RoW. In addition, specific borrow and disposal sites will not be known until they are identified by the developers in the bidding process.

Specific information on trucking operations is unknown at this time, as the highway design profile and quantity estimates, the geotechnical investigations and the developer selection have not been completed. As previously indicated in Section 3.4.1.2, all borrow and quarry operations will be conducted at approved sites in accordance with applicable laws and regulations, and Section 4.9 of the EPP.

Vehicles used in base and pavement construction include steel drum rollers, graders, trucks, and asphalt concrete pavers. If the asphalt concrete plant is located on-site and a suitable source of aggregate used for the asphalt concrete and road base construction can be found on-site, truck traffic during this phase of construction will be limited to the delivery of prime, tack coat, asphalt cement and diesel fuel. If the asphalt concrete plant is not located on-site and/or aggregate must be obtained from off-site sources, the amount of truck traffic on the access roads will increase accordingly. On-site aggregate material resources will be identified in the geotechnical survey. The location of imported aggregates will be determined by the developers.

Highway trucking of construction equipment and off-site imported and exported materials will be routed along the existing TCH, an all-weather Provincial truck route. Use of local and collector highways for access between the existing TCH and the proposed TCH will be subject to applicable Provincial gross vehicle weight maximums and spring weight restrictions.



Materials and Equipment Storage and Handling

Where appropriate, excavated material will be stored for later use. This material will be stored along the RoW or in a borrow site in such a way as to prevent sedimentation at any adjacent watercourses or wetlands. Section 4.9 and 4.17 of the EPP, Section 4.5 of the EFG, and the *Draft Guidelines for Pits and Quarries* (NBDELG 2000) will be followed.

In agricultural areas, excavated materials will be temporarily stockpiled along the RoW in accordance with the EPP (Section 4.13), separate from any topsoil or other material to be used in RoW reclamation. This material will be managed in critical areas to prevent erosion and the transport of sediment into watercourses. Delayed timing of vegetation removal and excavation of buffer zones at watercourse crossings will limit the duration of soil exposed to erosion in these areas.

Aggregates will be stored in such a way as to prevent their erosion or loss to watercourses or wetlands. The runoff from aggregate piles will be directed to a settling basin to be constructed to EFG specifications (Section 4.3.2 of the EFG).

Disposal Areas

The most desirable use of material excavated from the RoW during construction is use within the RoW (e.g., buried in the toe of the slope), assuming it conforms with technical standards. Disposal of waste materials from the construction of the proposed undertaking will be in accordance with NBDOT (2003) Standard Specifications and the EPP, the *Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site* (NBDELG 2002a), and any provisions included in site-specific contracts. Existing approved construction and demolition debris disposal sites may be used for disposal outside of the RoW.

Non-salvageable material from the clearing operations, such as limbs and timber, are typically chipped within the RoW and left in place except within buffer zones for watercourses and wetlands. Excavated organics, overburden and rock (where their use as fill material is impractical) must be disposed of properly. The disposal of surplus and unusable grubbed materials must follow NBDOT Specifications. Section 4.18 of the EPP indicates that waste disposal areas must be located such that they do not interfere with any stream or drainage facility (i.e., >30 m away), do not contribute to erosion and/or siltation, and are left in a neat appearance.

Asphalt Plants

Asphalt plants will be required for the manufacture of hot mix asphalt for paving. Nearby off-site quarries, or rock crushing sites within the RoW, may be used as asphalt plant locations to reduce the



haulage and storage of materials. Asphalt plants will be operated in accordance with applicable regulations (i.e., *Air Quality Regulation*) and appropriate mitigation will be applied (EPP, Section 4.15). The developer will be required to obtain the necessary permits for the operation of the asphalt plant, such as an Approval to Operate under the New Brunswick *Air Quality Regulation* and Petroleum Storage Approval under the *New Brunswick Petroleum Product Storage and Handling Regulation*.

3.4.1.6 Decommissioning of Temporary Facilities

Decommissioning involves the removal of temporary access roads and construction equipment and materials storage sites. The *Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site* (NBDELG 2002a), and the EPP, will be followed during decommissioning of all temporary facilities required for construction.

3.4.2 Operations Activities

Winter Safety

Winter highway operations activities generally involve snow removal and ice control to reduce traffic disruptions and safety hazards. Snow removal involves plowing services provided by, or contracted out and supervised by, local NBDOT Maintenance Depot employees. When snow banks build up along the highway, the snow is removed and dumped at a suitable site, not in wetlands or environmentally sensitive areas.

Road ice is controlled by the application of salt and sand. Salt is applied to roads to retain clear driving lanes within a reasonable time after a storm. Sand is applied to road surfaces to provide traction on snow-packed or icy roads. Currently the EPP (Section 6.2.1) identifies salt application protection measures. Application rates identified in the *Highway Maintenance Management System Field Manual* (NBDOT 1992a) will be used to maximize the efficiency of salting and sanding and minimize the potential environmental effects.

Environment Canada recently completed an assessment of road salt under the *Canadian Environmental Protection Act, 1999* (CEPA). Road salts that contain inorganic chloride salts are considered "toxic" as defined in Section 64 of CEPA. Recognizing that a total ban of road salt could potentially compromise human safety, the focus is on implementation measures that optimize winter road maintenance practices so as to not jeopardize road safety while minimizing the potential environmental effects (Environment Canada 2001c). Therefore, Environment Canada has categorized road salt as a Track 2 substance, requiring Life-Cycle Management.



Management instruments to reduce the potential environmental effects of road salts are being developed through a multi-stakeholder group (which involves representation from NBDOT) working in conjunction with Environment Canada. Proposed control measures will likely be presented in July of 2004. In accordance with Environment Canada's policy on road salt, all road agencies (e.g., NBDOT) must develop a Salt Management Plan. NBDOT is committed to developing "best salt management" practices in a continued effort to minimize and manage the potential environmental effects of road salts on the environment.

3.4.3 Maintenance Activities

Proposed TCH Maintenance

Highway maintenance activities retain roadways at a reasonable level of service, comfort and safety and typically take place during the summer months. The rate of degradation of the pavement surface will be determined by the volume of traffic, proportion of heavy trucks, certain vehicle characteristics (i.e., radial tires), structure and quality of pavement. The repair of the asphalt concrete surface may involve excavation or removal of the existing pavement and subgrade, patching and levelling, grading and gravelling, surface treatment and asphalt concrete overlays. Disruption to the public from these repairs would be temporary and infrequent in nature.

Periodic maintenance of roadway drainage systems may be required. This may involve the replacement or repair of culverts and re-establishment of the drainage ditches.

Other highway maintenance activities include shoulder grading, localized pavement repair, and line repainting. Again, disruption to the public from these repairs will be temporary and infrequent in nature.

The gravel surfaced property access roads will be graded during the summer season to retain cresting and to level potholes, ruts and bumps. Periodic application of liquid or flake calcium chloride may be required as a dust control measure.

Section 6 of the EPP contains the appropriate mitigation to be employed during these activities.

Maintenance of Vegetation and Wildlife Crossings

Regrowth of vegetation within the RoW may interfere with the lines of sight required for safe use of the highway. Clearing along the RoW is part of NBDOT's regular maintenance to maintain sight lines and may involve both manual and mechanized cutting. NBDOT does not use herbicide application for the control of vegetation. Maintenance of wildlife crossings and fencing will be conducted as required.



3.5 Accidents, Malfunctions, and Unplanned Events

All necessary precaution will be taken to prevent the occurrence of malfunctions and accidental events that may occur throughout all phases of the Project and to minimize any environmental effects should they occur. Accidental events with the greatest potential for environmental effects include:

- spills of hydrocarbons or other hazardous materials;
- failure of erosion and sediment control measure;
- bridge or culvert washout;
- fires;
- vehicular collisions;
- wildlife encounter; and
- disturbance of archaeological or heritage resource.

It is difficult to predict the precise nature and severity of these events. However, the probability of serious accidental events or those causing significant adverse environmental effects is low, particularly when construction and operation procedures incorporate contingency and emergency response planning. Construction and operation procedures will be conducted in accordance with the EPP, the EFG, and NBDOT (2003) Standard Specifications as well as all relevant regulations, guidelines and accepted industry procedure.

3.5.1 Hazardous Material Spill

Spills of petroleum, oils, or lubricants (POLs) may occur during construction during refuelling of machinery or through breaks in hydraulic lines. These spills are usually highly localized and easily cleaned up by onsite crews using standard equipment. In the unlikely event of a large spill, soil, groundwater, and surface water contamination may occur, thereby potentially adversely affecting the quality of groundwater, fish and fish habitat, and wetland habitat, and resulting in the ingestion/uptake of contaminants by wildlife. Depending on the nature of the spill, it could also potentially affect residential, commercial, agricultural, and other land uses.

The EPP and EFG contain best management procedures to minimize the likelihood of a spill. POLs and other hazardous materials will be handled in accordance with applicable regulations (*i.e.*, the *Petroleum Product Storage and Handling Regulation*) and procedures as noted in the EPP (Section 4.19) and EFG (Section 5.0). Construction equipment will be frequently inspected to detect possible fuel and hydraulic system leaks. Any leaks will be repaired immediately. Refuelling and equipment maintenance will be conducted at designated sites, away from residential and known cultural or heritage properties, and not within 30 m of a wetland or watercourse. A Spill Contingency Plan is also included in the EPP (Section 8.1) and the EFG (Section 5.7).



In the unlikely event of larger contaminant spills (*i.e.*, tanker accidents during operation), local and provincial emergency response procedures will be invoked to minimize potential environmental effects. Emergency response and contingency planning are accepted and effective means to limit the severity of environmental effects. These plans and procedures will be implemented through the EPP and supported through training programs.

3.5.2 Erosion and Sediment Control Failure

A potential exists for failure of erosion and sediment control structures due to precipitation events. Such a failure could result in the release of a large quantity of sediment-laden runoff to receiving watercourses with potential adverse effects on fish and fish habitat. Erosion and sediment control measures will be implemented according to the EPP (Section 4.5), the EFG (Section 4.2 and 4.3) and the NBDOT (2003) Standard Specifications and will be monitored by an environmental inspector, particularly after a heavy precipitation event or snow melt that results in the visible overland flow of water. Remedial action will be taken as necessary.

3.5.3 Bridge or Culvert Washout

A potential exists for a bridge or culvert structure to washout during a precipitation or storm event that substantially exceeds the design criteria for these structures, or as a result of culvert blockage by ice jams or debris. Current design standards are for 100 year peak discharge events. Mitigation would include closing down large structures to traffic during events of this magnitude and periodic inspection and maintenance of structures (*e.g.*, clearing debris from culverts). Maintenance of culverts will be done as per Section 6.1.5 of the EPP and maintenance of bridges will be done as per Section 6.3 of the EPP. Remedial action will be taken as necessary.

3.5.4 Fire

Fires may result in habitat loss, sensory disturbance, direct mortality to wildlife, loss or damage of property, and loss or damage to archaeological and heritage resources. Material management (*i.e.*, fuel and other hazardous materials) and operational procedures (*i.e.*, storage, handling and transfer) will reduce the potential for and extent of accidental fires related to the Project. In the unlikely event of a fire, local emergency response and fire fighting capability will be able to reduce the severity and extent of damage. A Fire Contingency Plan and fire prevention procedures are included in the EPP (section 8.4 and 7.4 respectively) to reduce the potential for fires.



3.5.5 Vehicular Collision

While traffic collisions are inevitable, the proposed TCH is expected to have a significantly improved collision rate compared with the existing TCH. Since this will be a new controlled access four-lane divided highway with a wide median, collision rates are expected to be considerably lower than those on the existing two-lane highway without access control. Diversion of through traffic, as well as part of the local traffic, to the proposed TCH, will improve the ease and safety of access for the remaining local traffic using the numerous road and driveway entrances within the zone of influence of the Project. Public concerns for safety will be further reduced since most of the heavy trucks will divert to the proposed TCH. Vehicular collision with wildlife is also possible and is included in this accident type.

3.5.6 Wildlife Encounter

There is the potential for workers to come into contact with wildlife during the construction and maintenance phases of the Project. This could have adverse environmental effects on both worker (e.g., disruption of work activity, or bodily harm) and wildlife (e.g., disturbance of critical life cycles). In case of persistent wildlife encounters, NBDOT personnel shall notify NBDNR of the situation (Section 8.2, EPP).

3.5.7 Disturbance of Archaeological or Heritage Resources

There is the potential for the unplanned disturbance or discovery of archaeological or heritage artifacts. A significant archaeological resource is defined as a site that contains features (non-removable indications of past human use and activity, such as a fire hearth, a living floor, or a burial site) in addition to artifacts. The likelihood of an accidental discovery of a significant site containing features is considered low due to the intensity of the subsurface testing at the major watercourse crossings and other potentially high risk areas. While it is possible that an individual artifact was missed during this survey, it is very unlikely that any archaeological features were not detected. The disturbance of an individual artifact is not considered significant. In the event of an unplanned encounter, all personnel will act in accordance with Section 8.3 of the EPP.

3.6 Environmental Management

3.6.1 Design and Construction

Environmental protection measures have been developed by NBDOT as a result of legislative requirements and a desire to improve highway design and construction methods and procedures, and to minimize the interaction between the NBDOT activities and the environment.



The original EPP was prepared by NBDOT after reviewing the EPP produced by NB Power (1991). Information included in the original EPP was compiled by various branches of NBDOT. The EPP is now in its third revision (NBDOT 1998a). The EFG is currently in its second revision (Washburn and Gillis 1998). These current editions of the EPP and EFG incorporate revisions and contributions provided by the following regulatory agencies:

- Environment Canada;
- Department of Fisheries and Oceans;
- Department of Fisheries and Aquaculture;
- New Brunswick Department of the Environment (now NBDELG); and
- New Brunswick Department of Natural Resources and Energy (now NBDNR).

The current EPP and EFG are endorsed by these agencies as the mitigation contained therein is intended to ensure that the potential environmental effects of NBDOT projects are managed and minimized so that significant environmental effects do not occur.

Environmentally responsible design elements of the proposed Project, such as culvert design and installation techniques, slope stability, and wildlife control will be made during the design stage following the guidance of this environmental assessment and implemented during construction. Technically and economically feasible methods for achieving standards and meeting regulatory requirements will be implemented for each construction activity.

NBDOT highways are constructed under contract through a public tendering process. The contract documents contain a description of the work, the standards under which it is to be carried out, and the results expected to be attained. Construction specifications not only provide design details, but also refer to management practices and contain environmental protection measures, as outlined in the EPP. Site specific protection measures are detailed in the Plans and Particular Specifications of the contract. The developers who are awarded NBDOT construction contracts will be qualified to do the work and will receive environmental awareness training. Construction developers will be responsible for following the contract specifications and complying with all requirements of the EPP, the EFG, and all applicable standards, guidelines and regulations during all phases of construction.

Construction will follow the EFG and the EPP, as well as the environmental section within the NBDOT (2003) Standard Specifications, which will provide mitigation on a number of design and construction related environmental concerns normally associated with roads and highways in New Brunswick. Other applicable standards and guidelines to be employed during construction include:

- *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada (TAC) 1999;



- *Guidelines for the Protection of Fish and Fish Habitat - The Placement and Design of Large Culverts, Fisheries and Oceans Canada, Maritimes Region (DFO 1999a)*
- Schedule A - Provincial Performance Standards for Development, Operation & Closure of Pits and Quarries in New Brunswick;
- *Draft Guidelines for Pits and Quarries, NBDELG (2000); and*
- *Watercourse Alteration Technical Guidelines, NBDELG (2002b).*

To ensure compliance with environmental standards and regulations, regular inspections and monitoring will be performed through consultation with the appropriate regulatory authority on the proper environmental practices.

Environmental protection control measures employed during construction will be inspected regularly. NBDOT will provide inspectors, or employ an independent agent for inspection and supervision services. Improperly installed or damaged environmental controls will be corrected immediately upon discovery. Inspections of the construction site to ensure compliance with the EPP will be conducted before and after major rain storm events.

Machinery will be inspected regularly to ensure they are properly maintained and minimize petroleum, oil, or lubricant (POL) leaks and drips. Employees and subcontractors will be required to implement appropriate control measures to minimize POL leaks during construction activities.

Emergency situations involving the accidental release of hazardous materials to the environment, accidental wildlife encounters, discovery of potentially sulfide bearing rocks or aggregate, discovery of historic resources, discovery of contamination, and fires will follow the contingency and emergency response procedures provided in Section 8.0 of the EPP.

3.6.2 Operations and Maintenance

Environmental protection procedures and measures will be observed and employed throughout the life of the proposed TCH, as outlined in Section 6.0 of the EPP. NBDOT will be responsible for installation, maintenance, and inspection and monitoring of environmental protection control measures during the operation and maintenance phase.



3.7 Project Schedule

The proposed four year construction schedule for the proposed TCH from Perth-Andover to Woodstock is of relatively short duration in comparison to most NBDOT highway development projects, and is more comparable to the schedule of the Route 2 - Fredericton to Moncton Highway Project. Some of the initial clearing and grubbing work could begin in the fall of 2004, but no other construction work is planned to commence prior to the 2005 construction season.

The project is tentatively planned to proceed over four years as prescribed in Table 3.7.1.

Table 3.7.1 Proposed Project Schedule

Activity	Schedule
Engineering Surveys	2004
Clearing and Grubbing	2004-2005
Grading	2005-2006
Gravel Subbase	2006-2007
Bridge and Grade Separation Structures	2005-2007
Paving and Shoulders	2007

The proposed construction schedule will afford very few phasing opportunities to open sections prior to completion of the entire Project. Most activities/phases of construction will be conducted simultaneously at various locations within the Project limits.

Earlier plans by NBDOT had considered constructing the interchange and the connector road to Hartland and phasing in the 13 km section from Woodstock to Hartland prior to completion of the Perth-Andover to Hartland segment. However, there is no commitment to this phased-in approach at this time. The Lockhart Mill Road interchange at Jacksonville (near Woodstock) is presently under construction, and will be opened for the existing two lanes in 2004. Its construction to a twinned four-lane configuration will coincide with the rest of Project in 2007.

A benefit of this accelerated schedule will be that it will place a limit on the length of time local area residents will be exposed to any potential environmental effects that may arise during the construction phase, such as increased truck traffic, dust, and noise from blasting activities. It will also provide users the full travel savings and safety benefits at an earlier date.





4.0 ISSUES SCOPING AND ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1 Environmental Assessment Methodology

The methodological approach employed in this EA provides an evaluation of Project-related environmental effects following the methodological framework described by Barnes *et al.* (2000). The approach is designed to address the scope of the Project and the factors to be considered as outlined in Sections 15 and 16 of *CEAA* and as determined by the responsible authorities in their scope determination thereunder (Guidelines, Appendix A).

The approach follows six basic steps to assess environmental effects. These are:

1. Identify the issues through scoping and select Valued Environmental Components ("VECs") on which to focus the environmental assessment;
2. Establish boundaries for the environmental assessment and residual environmental effects rating criteria ("thresholds of significance") for determining the significance of environmental effects for each VEC;
3. Identify environmental effects of Project activities, by Project phase and also the changes to the Project caused by the environment;
4. Evaluate environmental effects using the significance criteria identified in Canadian Environmental Assessment Agency (the "Agency") guidance documentation (*CEAA* 1994) in light of proposed mitigation;
5. Analyze the environmental effects and predict their significance by applying the residual environmental effects rating criteria; and
6. Outline a monitoring and follow-up program, as required.

The following describes the above noted steps that are followed for this EA.

4.1.1 Step 1—Scoping of Issues and Selection of Valued Environmental Components

Scoping involves consultation with all stakeholders, including the general public, responsible authorities under *CEAA*, regulatory authorities and the Aboriginal community to identify the issues that need to be addressed in the environmental assessment. It also involves the application of professional judgement by



the authors of the environmental assessment report, including the consideration of baseline studies undertaken for the Project.

A key objective during the issues scoping process is to identify the best way to organize or "package" issues into VECs that make sense for the focused analysis of potential environmental effects. Importantly, scoping is also a useful tool for the responsible authorities to exercise their discretion to determine the scope of the environmental assessment pursuant to Sections 15 and 16 of *CEAA*.

For the biological and physical environment, VECs may represent "key" or "indicator" species, communities, species groups, or ecosystems, as well as, "pathways" (e.g., air, water), which act as media for the transfer of environmental effects. VECs may also reflect issues that are socially, culturally or economically of value. The ultimate decision on what should be the VEC or VECs must reflect an informed understanding of the potential Project-environment interactions, the importance of components to ecological integrity, their sensitivity to the planned perturbations, and the values of society. Regardless, practitioners must use their good professional judgement in consideration of all or many of these factors, including the opinions expressed to them by the various participants during the scoping process.

4.1.2 Step 2—Establish Boundaries and Residual Environmental Effects Rating Criteria

4.1.2.1 Boundaries

An important aspect of the environmental assessment process is the determination of boundaries because they focus the scope of work, allowing for a meaningful analysis of potential environmental effects associated with a project. The setting of boundaries also aids in determining the most effective use of available study resources. There are two distinct types:

- temporal and spatial boundaries of the project and the VEC; and
- administrative and technical boundaries of the assessment.

The first type of boundary is defined by the temporal and spatial characteristics of the project and various VECs. For example, ecological, socio-cultural, economic, health, heritage, traditional land use, and project boundaries are of this type. These boundaries encompass those periods and areas during, and within which, the VECs are likely to interact with, or be influenced by, the project. These boundaries may extend well beyond physical project limits, even the limits of potential direct interactions between the project and the VECs, particularly in the case of migratory species, or regional or national socio-cultural and economic systems.

The second type of boundary addresses the limitations on the scope of, or approach to, work during the assessment of environmental effects. These boundaries are referred to as administrative boundaries and



technical boundaries to the assessment, and are imposed by such factors as finite resources of data, time, cost, and labour, as well as technical, political, or administrative reasons or jurisdictions.

Administrative boundaries refer to the temporal and spatial dimensions imposed on the environmental assessment for political, socio-cultural, and economic reasons. Technical boundaries represent the technical limitations on the ability to evaluate or predict potential environmental effects of the project. For example, it may be difficult to measure or predict the number of individuals of any particular species that might be affected by a project. Where such technical boundaries exist, it is important that they be acknowledged, and alternative strategies used to characterize the VEC and/or environmental effects be described.

4.1.2.2 Residual Environmental Effects Rating Criteria

Fundamental to the approach described by Barnes *et al.* (2000) is the determination of significance. Under *CEAA*, the determination of significance is central to decision-making. Rating criteria are specifically defined for each VEC to provide the threshold for determining the significance of residual environmental effects. These "residual environmental effects rating criteria" or "significance thresholds" are established based on information obtained during issues scoping, available information on the status and characteristics of the VEC, and professional judgement.

The evaluation criteria recommended by the Agency (*CEAA* 1994) to assist in the determination of significance are used to frame specific definitions for the determination of significance, as appropriate. These significance thresholds determine at which point the VEC would experience environmental effects of sufficient geographic extent, magnitude, duration, frequency and/or reversibility to affect its integrity (each of these are described in more detail in Step 5). These Agency evaluation criteria help to frame significance thresholds that reflect the sensitivity of the VEC to perturbation and its ability to recover.

In developing residual environmental effects rating criteria, one first needs to define which population, stock, community, or ecosystem is represented by the VEC, or in the case of abiotic biophysical components like air quality, which airshed(s) are affected. For socio-cultural and economic VECs, one must determine the people, groups of people or communities that are affected.

The challenge in determining whether or not environmental effects are significant is that some considerable degree of professional judgement is normally needed to evaluate whether the predicted environmental effects, (e.g., loss of habitat, mortality, change in land use) will exceed the designated threshold of significance. In most cases the significance is obvious when compared to the criteria in light of the various data and information contained in the analysis. However, in some instances, lack of previous experience, insufficient data, or the use of predictive tools may cast sufficient uncertainty that it may be difficult to apply the criteria with a high degree of certainty. This is a technical limitation or



boundary of the environmental assessment. A precautionary approach to mitigation or the crafting of significance criteria that incorporate some appropriate margin of safety to compensate for the level of uncertainty can assist in dealing with this potential methodological challenge should it arise.

4.1.3 Step 3 - Identification of Project Environmental Effects

This step involves the identification of VEC-specific Project related environmental effects (*i.e.*, Project-VEC interactions) and a description of issues and concerns regarding key interactions. Table 4.1.1 presents a breakdown of the Project activities required to complete each of the Project phases as described in Section 3.0.

Table 4.1.1 Description of Project Activities and Physical Works

Project Phase	
Category	Project Activities and Physical Works
Construction	
Site Preparation	Includes all Project-related activities associated with preparing the proposed TCH* for roadbed preparation. Project-related activities include: • surveying; • clearing; • grubbing; and • modification, relocation, or removal of obstructions.
Roadbed Preparation	Includes all Project-related activities associated with preparation of the proposed TCH roadbed to the stage where it is ready for paving. Project-related activities include: • blasting; • excavation; • placement of fill; and • grading.
Watercourse Crossing Structures	Includes all Project-related activities that are required wherever the proposed TCH crosses a watercourse. Watercourse crossing structures include a variety of culvert types and bridge designs. Project-related activities include: • site preparation; • stream diversion (as applicable); • installation; and • site restoration.
Surfacing and Finishing	Includes all Project-related activities that are required to make the proposed TCH roadbed suitable for public use. Project-related activities include: • paving; • line painting; • installing guiderails; • installing signage; and • installing wildlife fencing, crossings, and other deterrents (e.g., vegetation).



Table 4.1.1 Description of Project Activities and Physical Works

Project Phase	
Category	Project Activities and Physical Works
Ancillary Structures and Facilities	Includes all Project-related activities that are required for the construction, operation, and removal of temporary ancillary structures and facilities. Removal may require site restoration. Temporary ancillary structures and facilities include: • temporary site access roads; • borrow areas; • petroleum storage areas; • equipment receiving areas; • handling and storage areas; • disposal sites; and • asphalt plants.
Operation	
Winter Safety	Includes all Project-related activities that are required for the safe operation of the proposed TCH during adverse winter weather conditions, including: • salting; • sanding; and • plowing.
Proposed TCH Presence	Includes all Project-related aspects that will be present for the life of the Project, including: • presence of the paved roadway within RoW; • presence of vehicular traffic; • presence of watercourse crossings and bridges; • presence of ancillary structures and facilities; and • presence of wildlife fencing and crossings.
Maintenance	
Proposed TCH Maintenance	Includes all Project-related activities that are required to maintain the following: • pavement; • lines; • signage, guiderails and reflectors; and • watercourse crossing structures.
Vegetation and Wildlife Maintenance	Includes all Project-related activities that are required to maintain the following: • vegetation; and • wildlife fencing and crossings.

* proposed TCH refers to all permanent roadbed and structural features including the four-lane highway, interchanges, existing road improvements, and remnant property access roads.

In order to standardize this step and in keeping with standard practice, a project activity-environmental effects interaction matrix is used for each VEC (Table 4.1.2). It describes the scope of the environmental assessment for each VEC and is limited to only those interactions identified through scoping. Although not identified in the table, at this step, the changes of the Project caused by the environment (e.g., extreme natural events such as floods or earthquakes) is assessed.



Table 4.1.2 Project Activity – Environmental Effects Interaction Matrix for [Name of Environmental Component]

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>NAME OF ENVIRONMENTAL COMPONENT</u>			
Project Activities and Physical Works †	Potential Environmental Effects		
	Effect 1	Effect 2	Effect 3
Construction			
Site Preparation			
Roadbed Preparation			
Watercourse Crossing Structures			
Surfacing and Finishing			
Ancillary Structures and Facilities Construction			
Operation			
Winter Safety			
Proposed TCH Presence			
Maintenance			
Proposed TCH Maintenance			
Vegetation and Wildlife Management			
Accidents, Malfunctions and Unplanned Events*			
Accident #1			
Accident #2			
† Table 4.1.1 for list of specific activities and works) * Only those accidents that are relevant to the VEC are included. Section 3.5 provides a list and description of possible accidents, malfunctions, or unplanned events.			

4.1.4 Step 4 – Evaluation of Environmental Effects

The next step in the assessment process consists of the evaluation of potential residual environmental effects of the Project, by Project phase, in light of proposed specific mitigation and the evaluation criteria for determining significance described by the Agency (CEAA 1994). The purpose of this step is to evaluate the interactions between project activities and the VECs and to determine the nature and extent of residual environmental effects, i.e., those environmental effects that may persist after all mitigation strategies have been implemented. As most projects involve at least some kind of environmental effect, it has become practice to evaluate the significance of those. The significance of environmental effects is determined in Step 6, on the basis of the evaluation conducted in Steps 4 and 5.

The evaluation of environmental effects takes into consideration:

- the potential interaction between project activities, for each of the project phases, and their environmental effects (as described in Step 4);
- the mitigation strategies applicable to each of the interactions; and

- the Agency's evaluation criteria for determining significance (CEAA 1994) and any other evaluation criteria established by the study team to further characterize the nature and extent of the environmental effects, where required.

An environmental effects assessment matrix template is used to summarize the analysis of environmental effects by project phase, including malfunctions, accidents and unplanned events (Table 4.1.3). This allows for a comprehensive analysis of all project-VEC interactions in a matrix format. Supporting discussion in the accompanying text highlights particularly important relationships, data, or assessment analysis, but does not necessarily address all items noted in the table.

Table 4.1.3 Environmental Effects Assessment Matrix for [Name of Environmental Component]

Environmental Effects Assessment Matrix Valued Environmental Component: <u>NAME OF ENVIRONMENTAL COMPONENT</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects (A = adverse; P = Positive)	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Construction							
Site Preparation							
Roadbed Preparation							
Surfacing and Finishing							
Watercourse Crossing Structures							
Ancillary Structures and Facilities Construction							
Operation							
Winter Safety							
Proposed TCH Presence							
Maintenance							
Proposed TCH Maintenance							
Vegetation and Wildlife Management							
Accidents, Malfunctions and Unplanned Events							
Accident #1							
Accident #2							



Table 4.1.3 Environmental Effects Assessment Matrix for [Name of Environmental Component]

Environmental Effects Assessment Matrix Valued Environmental Component: <u>NAME OF ENVIRONMENTAL COMPONENT</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects (A = adverse; P = Positive)	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Key: Magnitude*: 1 = Low: e.g., employment and business opportunities are affected for eighteen months. 2 = Medium: e.g., employment and business opportunities affected for more than eighteen months but less than the life of the Project. 3 = High: e.g., employment and business opportunities affected for longer than the life of the Project or irreversibly. Geographic Extent: 1 = < 1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Frequency: 1 = < 11 events year 2 = 11 - 50 events year 3 = 51 - 100 events year 4 = 101 - 200 events year 5 = >200 events year 6 = continuous Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible N/A = Not Applicable (A) = adverse (P) = positive						

*these magnitudes definitions are typical for socio-economic VECs.

4.1.4.1 Classifying Potential Environmental Effects

The concept of classifying environmental effects simply means determining whether they are adverse or positive. This is indicated in Table 4.1.3 by the simple use of a bracketed ("A") or ("P"). The following includes some of the key factors that can be considered for determining adverse environmental effects, as per the Agency guidelines (CEAA 1994):

- Negative environmental effects on the health of biota;
- Loss of rare or endangered species;
- Reductions in biological diversity;
- Loss or avoidance of critical/productive habitat;
- Fragmentation of habitat or interruption of movement corridors and migration routes;
- Transformation of natural landscapes;
- Discharge of persistent and/or toxic chemicals;
- Toxicity effects on human health;
- Loss of, or detrimental change in, current use of lands and resources for traditional purposes;
- Foreclosure of future resource use or production; and
- Negative effects on human health or well being.



4.1.4.2 Mitigation

Mitigation includes Project design, environmental protection strategies, and mitigation specific to the minimization or control of potential adverse environmental effects on a particular VEC. As required by *CEAA*, these measures must be technically and economically feasible. In the case of beneficial environmental effects, enhancement opportunities (e.g., maximize opportunities for local suppliers and developers) are considered. The environmental effects analysis will be undertaken in consideration of the proposed mitigation and environmental effects predictions. Environmental effects remaining after mitigation will be determined to be residual environmental effects. Current NBDOT environmental management practices will be factored into the overall mitigation strategies that will be specifically included for the proposed Project. Table 4.1.3 summarizes specific mitigation for each environmental effect.

4.1.4.3 Application of Evaluation Criteria for Assessing Environmental Effects

Several criteria are taken into account when evaluating the nature and extent of environmental effects. These criteria include, as stated previously (*CEAA* 1994):

- magnitude;
- geographic extent;
- duration and frequency;
- reversibility; and
- ecological, socio-cultural, and economic context.

Each criterion has a numeric descriptor in the key of the environmental effects assessment matrix (Table 4.1.3) to simplify the presentation of results of the environmental assessment and reflect different levels at which the criterion applies. The key is modified as appropriate for each VEC.

4.1.5 Step 5 – Analysis and Prediction of the Significance of Environmental Effects

The analysis and prediction of the significance of environmental effects encompasses the following:

- determination of the significance of residual environmental effects for each phase of the project and for the project overall; and for any predicted significant environmental effects;
- establishment of the level of confidence for predictions; and
- determination of scientific certainty and probability of occurrence of the predicted residual environmental effects.



Upon completion of the evaluation of environmental effects in Step 5, the residual environmental effects are assigned an overall rating of significance for each of the project phases (e.g., construction, operation, decommissioning, and malfunctions, accidents, and unplanned events) and for the project overall.

These are presented in the residual environmental effects summary template (Table 4.1.4). This table provides a phase-by-phase and a Project overall residual environmental effects rating. Where significant adverse or positive residual environmental effects are predicted, a level of confidence and likelihood of occurrence rating are also given to each prediction.

Table 4.1.4 Residual Environmental Effects Summary Matrix for [Name of Environmental Component]

Residual Environmental Effects Summary Matrix Valued Environmental Component: <u>NAME OF ENVIRONMENTAL COMPONENT</u>				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction				
Operation				
Maintenance				
Accidents, Malfunctions and Unplanned Events				
Project Overall				
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

4.1.5.1 Significance Rating

Taking into consideration the analyses conducted in Steps 4 and 5, a phase-by-phase and an overall rating of significant or not significant is assigned. A rating of positive may also be applied where the environmental effects are found to be positive rather than adverse. Specific thresholds for determining significance are developed for a VEC to reflect the distinction between those environmental effects that should or should not be collectively considered significant (Step 2).

The rating of significance is determined by the aggregate consideration of project-related environmental effects against the thresholds that have been established for the specific VEC, and within the defined environmental assessment boundaries established for that VEC. Significant environmental effects are those which are considered to be of sufficient magnitude, duration, frequency, geographic extent, and/or reversibility to cause a change in the VEC that will alter its status or integrity beyond an acceptable level.



Establishment of the criteria is based on professional judgement, but is transparent and in consideration of public, regulatory and Aboriginal consultation. The capacity of renewable resources(*i.e.*, those that are likely to be affected by the Project) to meet the needs of the present and those of the future is considered during the determination of significance.

4.1.6 Step 6 – Monitoring and Follow-up

As part of the environmental effects analysis, appropriate monitoring and follow-up are described. In developing a follow-up program, the results of Steps 1 through 6 are helpful in focusing on important interactions, where there is a high level of uncertainty about environmental effects predictions, where significant environmental effects are predicted, or in areas of particular sensitivity.

4.1.6.1 Changes to the Project that may be caused by the Environment

In addition to the seven-step process for evaluating the environmental effects of the Project it is also necessary to consider those changes to the Project that may arise as a result of the environment. For example, natural phenomena like severe weather, forest fires, floods and earthquakes can result in environmental effects as defined in *CEAA*. These effects of the environment on the Project are addressed in a separate section at the end of the environmental effects analysis.

4.2 Issues Scoping and Selection of Valued Environmental Components

The issues scoping process began with the review of the Environmental Impact Assessment Registration review by the Province. The Project was registered by NBDOT in February 2002. NBDELG responded to the registration with a list of questions/concerns and request for additional information from the EIA Technical Review Committee (TRC), requesting that they be addressed prior to issuing a Determination on the Project. In an effort to respond to the TRC's questions/concerns and requests in a timely manner and in advance of the CSR, NBDOT commissioned a number of consultants to conduct and report on the environmental/baseline conditions within the zone of influence of the Project. Dillon Consulting Limited conducted field studies and reported on the Woodstock to Florenceville section (Dillon 2003), ACER Environmental Services Ltd. on the Florenceville to River de Chute (Route 560) section (ACER 2003), and Jacques Whitford Environment Limited on the River de Chute (Route 560) to Perth-Andover section (JWEL 2003). The reports were submitted to the TRC in May 2003.

Consultation with regulatory agencies, other stakeholders, and the public, in relation to the proposed Project has been ongoing for a number of years. This consultation and subsequent negotiations and compensation has contributed substantially to corridor and route selection and adjustments and ultimately to selection of the proposed alignment. In addition, these consultations were considered during the development of the Guidelines (Appendix A), and during the subsequent selection of VECs (Section 4.2).



4.2.1 Consultation

Consultation is the process by which interested parties are provided opportunity to contribute to the scoping of the project and the assessment as per Section 16 (1)(C) of *CEAA*, and/or to contribute local knowledge or expert advice useful for conducting the environmental assessment. This process includes consultation with members of the public, stakeholders, Aboriginal persons, and regulatory agencies and experts.

4.2.1.1 Consultation with the Public

Consultation with the public regarding the proposed Project has been ongoing for a number of years. Members of the general public comprised mainly of those affected or likely to be affected by the proposed Project, as well as the media, have participated in meetings hosted by NBDOT since 1998. During the Public Information Sessions, attendees were greeted and invited to view the displays of the proposed alignment and speak with NBDOT personnel on-hand.

The NBDOT distributed information bulletins to landowners directly affected by the proposed Project to alert them of the upcoming public information sessions. Announcements of the sessions were also made on radio and television, and published in local newspapers. Posters announcing the sessions were also erected in various businesses and public places within the nearby communities. Regulatory agencies and other stakeholders were also advised of the sessions.

NBDOT kept a record of those who attended the various Information Sessions. Issues, questions and concerns raised were addressed by NBDOT staff and tracked as they developed during the public consultation process. Most of the questions and issues brought forth by the attending public were answered to the satisfaction of the attendees.

Members of the public have also contacted the NBDOT on a number of separate occasions, either by mail, fax, or phone, with additional questions, comments, and concerns related to the Project.

Over the course of the public consultation process a number of common issues, questions and concerns were raised regarding private water supplies, increased noise levels, loss of quality of life, property access, access roads, loss of livelihood due to property severance and loss of revenue due to by-pass of businesses.

A general summary table presenting the highlights of the public consultation is presented at the end of Section 4.2.1. A brief summary of the key issues raised during the public consultation process is presented thereafter.



4.2.1.1.1 Public Open Houses

A number of public information sessions have been held by the NBDOT to allow the general public to view the proposed alignment plans and to allow the public to voice any issues that they had concerning the proposed alignment. This information was used in the determination of the final alignment, and is presented in Section 2.2.

In addition to issues regarding the alignment of the proposed TCH, a variety of other issues were raised during public consultation that were determined to be relevant to the environmental assessment. These are described in the following sections.

Public Open Houses - June 1998

The first sessions were held over four consecutive nights: at Woodstock on June 22, 1998, Hartland on June 23, 1998, Florenceville on June 24, 1998, and Perth-Andover on June 25, 1998. The TCH alignment was presented. Landowners whose land would be directly affected by the proposed alignment were advised of the upcoming meetings. Overall the comments at the information sessions were positive, especially from landowners along the existing TCH and by those who agreed with the need for a four-lane highway to improve highway safety and reduce travel time. Major non-alignment related issues included: increased noise; access to severed property; environmental effects on water supply; loss of income due to businesses being by-passed; loss of agricultural/farmland and woodlots; and environmental effects on watercourses and wildlife. Also raised was the need for an interchange between Perth-Andover and Florenceville.

Public Open Houses - March and April 1999

Changes were made to the initial alignment due to comments received during the June 1998 meetings, and follow-up public information sessions were held at the Carleton Civic Centre in Woodstock on March 18, 1999 and at the Florenceville Middle School on April 13, 1999 to present these changes. Approximately 200 people attended each of these sessions. Reaction was mixed with many in favour of the changes to the alignment.

The issues raised at these meetings were predominantly related to effects on property caused by the proposed TCH. There remained a number of people that wanted an interchange between Perth-Andover and Florenceville.



Public Open Houses – June 2003

The third series of public information sessions were held June 24th through 26th, 2003 to present the latest modifications to the alignment due to recommendations made by the public and due to the identification of rare plants in the River de Chute area. Only minor changes and adjustments were made to the alignment.

A number of non-alignment related issues were raised again during the 1998 public open houses. Issues raised during the open house and on exit questionnaire forms included water supplies (both groundwater and spring fed), highway drainage, access to remnant portions of divided properties, loss of wildlife (particularly moose) habitat, possible destruction of watercourses, decrease of property value, noise, and safety.

4.2.1.1.2 Communication with Affected Landowners

NBDOT has advised landowners that would be directly affected by the proposed Project. Alignment related issues are discussed in Section 2.2, and the compensation measures for relocation are presented in Section 5.8.

4.2.1.2 Consultation with Aboriginal Persons

Consultation with First Nation is required to assess any potential environmental effects of the Project on current use of land and resources for traditional purposes by Aboriginal Persons. There are six First Nations communities in the Saint John River Valley. These communities are: Madawaska, Tobique, Woodstock, Kingsclear, Oromocto, and St. Mary's First Nations. All of these communities needed to be included, or given opportunity to participate in the consultation process.

A Traditional Ecological Knowledge (TEK) study funded by NBDOT was undertaken by the Tobique Economic Development Corporation (TEDCO) on behalf of the Chiefs of the six Maliseet First Nations communities. .. The report resulting from this study, while completed, has not been made available to NBDOT to date. Representatives of TEDCO (C. Cameron, pers. comm.) have provided a brief summary of issues raised in this study. The TEK study involved the soliciting of relevant information from elders, traditionalists, and resource users (e.g., hunter, fishers, gatherers) within each community to determine if the proposed Project has the potential to interact with current use of traditional resources for traditional purposes by Aboriginal Persons. Selected site visits may have been conducted as a result of the information gathered during the review. This process included a presentation of the results to the leadership of each Maliseet community.



In addition to the TEK study there has been a Maliseet Nation consultation initiative. This activity consisted of a series of open houses, one at each Maliseet community. Information such as the proposed alignment and results of any environmental studies that have taken place were presented at the open houses and copies of all environmental reports related to the Project were made available in each community. Feedback sought and obtained during this consultation process is incorporated into the Comprehensive Study Report. More details of this consultation process and the TEK study methodology are provided in Section 5.9.2.2.

4.2.1.3 Consultation with Stakeholder, Regulatory Agencies and Experts

During the scoping process and for purposes of conducting the environmental assessment, a number of stakeholders and provincial and federal government agency experts were contacted and provided with the opportunity to express issues regarding the Project or to offer expert advice of knowledge for the purpose of assessing the environmental effects of the Project in respect of their mandate. Table 4.2.1 presents a comprehensive list of those contacted and their affiliation. Section 4.2.1.4 presents a summary of issues raised.

Table 4.2.1 List of Stakeholder and Regulatory Contacts

Contact	Affiliation
Agriculture	
Jean-Louis Daigle	Eastern Canada Soil and Water Conservation Centre (Université de Moncton)
Brian DuPlessis	Professional Agrolgists of NB Carleton Co Local Chapter
Peter Brennan	Dept. of Agriculture, Fisheries and Aquaculture
Betty Brown	New Brunswick Partners in Agriculture (formerly NB Farm Women's Organization)
Katrina Nicholls	Agriculture Producers Association of NB
Joe Brennan	Agriculture Producers Association of New Brunswick
Susannah Banks, Henk Tepper, and Gerard Pickard	Soil and Crop Improvement Association of New Brunswick
Jacques Laforge	NB Dairy Producers Association
Kevin Antworth	NB Cattle Marketing Agency
Roy Culberson	Potato Shipper's Association
Erica Fava	Agricultural Producers Association of New Brunswick
Robert Kee	Department of Agriculture, Fisheries and Aquaculture, Finance
Patton McDonald	Potato New Brunswick
George Maicher	Department of Agriculture, Fisheries and Aquaculture
Emery Bernard	Department of Agriculture, Fisheries and Aquaculture
Lynn M. Moore	Department of Agriculture, Fisheries and Aquaculture
Wayne O'Brien	Enterprise Carleton Region
Gary Melanson	Enterprise Carleton Region
John Russel	Agricultural Producers Association of New Brunswick
Loretta Mikitzel	Department of Agriculture, Fisheries and Aquaculture (Wicklow)
Colleen Brown	Department of Transportation
Raymond John	Department of Transportation
Ed Crandlemier	Dairy Producers Association
Archaeological And Heritage Resources	
Patricia Allen	Culture and Sports Secretariat
Albert Ferguson	Culture and Sports Secretariat



Table 4.2.1 List of Stakeholder and Regulatory Contacts

Contact	Affiliation
Gilles Bourque	Culture and Sports Secretariat
Allan Seaman	NBDNR
Reg Wilson	NBDNR
Fish And Fish Habitat	
Ted Currie	DFO
Emile Arseneau	DFO
Kim Dickenson	DFO
Ross Jones	DFO
Pam Seymour	NBDNR
Joey Garnett	NWPA
Rick Cunjak	Canadian Rivers Institute
Allen Curry	Canadian Rivers Institute
Stephen Wilson	Meduxnekeag River Association
Forestry	
Tim Fox	Carleton Victoria Forest Products Marketing Board
Simon J. Mitchell	Falls Brook Centre
Alfred Watson	Infor (Forest Information)
Donald Crabbe	H.J. Crabbe and Sons Ltd.
Jamie Simpson	Nature Trust of New Brunswick
Dale Wilson	NBDNR
Genevieve MacRae	Infor (Forest Information)
Peter Demarsh	New Brunswick Federation of Woodlot Owners
Groundwater Resources	
Michelle Paul-Elias	NBDELG
Gina Guidice	NBDELG
Karen White	NBDELG
Wendy Barner	NBDELG
Land Use	
Bea Giberson	Woodstock Chamber of Commerce
Ken Harding	CAO, Town of Woodstock
Diedre McLatchy	Village of Florenceville
Nancy Shaw	Village of Bristol
Christa Walton	Village of Bath
Judy Dee	Town of Hartland
John Craig	Central Business Association, Hartland
Teresa Burt	Village of Centreville
Dan Dion	Tourism and Business Development, Village of Perth-Andover
Tony Desjardins	Town of Grand Falls
Darlene Francoeur	Village of Aroostook
Jennifer Griffiths	Rural Planning District Commission
Gerret Hockman	Woodstock Rural Planning District Commission
Michael Lang	Director, La Vallee District Planning Commission
Gérard Lévesque	Victoria - Madawaska South Business Development Centre
Carl Peterson	Simonds Local Service District
Francois Picard	Enterprise Grand Falls Region
Dale Clark	Outfitter, Knoxford Lodge
Alton Morrison	Outfitter, Deerville Camps Ltd.
Julius Tarjan	Operations, Mount Carleton Provincial Park
Ross Antworth	New Brunswick Federation of Snowmobile Clubs
Rino Martin	New Brunswick ATV Federation Inc.
Steve Fenety	New Brunswick Trails Council Inc.



Table 4.2.1 List of Stakeholder and Regulatory Contacts

Contact	Affiliation
Ralph Boyd	Atlantic Provinces Trucking Association
Bill Thompson	NB Tourism and Parks
Jane Garbutt	NB Tourism and Parks
Joel Richardson	NB Tourism and Parks
Eddie Van Dam	NB Tourism and Parks
Jean Finn	NB Tourism and Parks
Kathy Wyrwas	NB Finance
Marie-Josée Hodgert	Statistics Canada
Rod Cumberland	NB Department of Natural Resources
Janet Higgins	NB Department of Natural Resources
Gregory Thompson	NB Department of Training and Employment Development
Peter Kavanagh	NB Environment and Local Government
Wendy Barner	NB Environment and Local Government
Samantha Schaffer	NB Environment and Local Government
Other Projects for Cumulative Environmental Effects Analysis	
Dave Maguire	NBDELG
Bernie Doucet	NBDELG
Surface Water Resources	
Matthew Dickson	NBDELG
Vegetation	
Maureen Toner	NB Department of Natural Resources
Stephen Gerriets	ACCDC
Sean Blaney	ACCDC
Jamie Simpson	Nature Trust of New Brunswick, Appalachian Hardwood Forest
Dr. Jim Goltz	
Wetlands	
Al Hanson	Canadian Wildlife Services
Todd Byers	NB Department of Natural Resources
Danny Crain	NB Department of Natural Resources, Wetland Inventory
Andrew MacInnis	Ducks Unlimited
Wildlife	
Dan Busby	Canadian Wildlife Services, Migratory Birds
Cade Libby	NB Department of Natural Resources, Fur Bear Biologist
Norman Prentice	NB Department of Natural Resources, Region 4, Moose and Deer
Environmentally Significant Area	
Jamie Simpson	Nature Trust of New Brunswick
Stephen Gerriets	ACCDC

4.2.1.4 Summary of Consultation Issues

A summary of key issues raised during the public and stakeholder consultation is provided in Table 4.2.2. The issues are separated into three categories (Land Use, Employment and Business, and Environmental) and the location in the CSR where this issue is considered/addressed is indicated.



Table 4.2.2 Summary of Key Public and Stakeholder Issues*

Issue	Location in CSR
Land Use	
Access to divided property	Section 5.8
Decrease of property value	Section 5.8
Direct environmental effect on houses	Section 5.8
Increased noise levels	Section 5.1, 5.8
Loss of community, as proposed TCH will divide the village of Jacksonville	Section 2.2, 5.8
Loss of quality of life due to proximity to home	Section 5.8
Increased local traffic in Jacksonville	Section 5.8
Employment and Business	
Loss of business due to bypass	Section 5.11
Loss of livelihood	Section 5.8, 5.11
Environmental effects on and/or loss of agricultural/farmland	Section 5.8, 5.11
Environmental effects on and/or loss of woodlot (sugar maple)	Section 5.8, 5.11
Environmental	
Air quality problems from highway traffic	Section 5.1, 5.8
Drainage of highway	Section 5.3
Loss of fish habitat	Section 5.4
Loss of wildlife habitat	Section 5.7
Environmental effects on water supply	Section 5.2
Environmental effects on watercourses	Section 5.3, 5.4

*This summary does not include issues related to the proposed alignment (See Section 2.2)

All issues raised during public consultation were reviewed and evaluated for their relevance to the environmental assessment, as per the guidance of the Guidelines (Appendix A). This information was considered during the scoping process and selection of the VECs.

4.2.2 Scope of the Project and Assessment

Transport Canada and Fisheries and Oceans Canada have prepared *Guidelines for the Preparation of a Comprehensive Study Report for the Perth-Andover to Woodstock Twinning of Route 2 – Trans-Canada Highway Project* (Appendix A) pursuant to their authority as responsible authorities under the *CEAA*. The Guidelines detail the scope of the Project and of the assessment and have been accepted by the RA. It was based on issues and concerns articulated by provincial and federal regulatory authorities (the TRC) following the review of the EIA registration, and any subsequent meetings and correspondence with the regulators and the proponent (NBDOT).

The following are mandatory factors to be considered for a comprehensive study level assessment as described in section 16(1) and (2) of *CEAA*:



16(1)

- (a) the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;*
- (b) the significance of the effects referred to in paragraph (a);*
- (c) comments from the public that are received in accordance with this Act and the regulations;*
- (d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and*
- (e) any other matter relevant to the screening, comprehensive study, mediation or assessment by a review panel, such as the need for the project and alternatives to the project, that the responsible authority or, except in the case of a screening, the Minister after consulting with the responsible authority, may require to be considered.*

16(2)

- (a) the purpose of the project;*
- (b) alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;*
- (c) the need for, and the requirements of, any follow-up program in respect of the project; and*
- (d) the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.*

This comprehensive study considers the potential environmental effects of the proposed Project within spatial and temporal boundaries which encompass the periods and areas during and within which the Project may potentially interact with, and have an environmental effect on, components of the environment.

4.2.2.1 Scope of the Project

The scope of the project refers to the various components of the proposed undertaking that will be considered as the Project for the purpose of the environmental assessment. Specifically, the scope of the Project determined and approved by Transport Canada and Fisheries and Oceans Canada (Appendix A) pursuant to their authority under Section 15(1) of *CEAA* is the construction, operation and maintenance of the 70.7 km highway to be constructed between Perth-Andover and Woodstock and any required ancillary works associated with those phases. Ancillary works includes construction, operation and maintenance of all required interchanges, new road connections, modifications to existing roads to ensure proper integration with the new highway, watercourse crossings and bridges, modification, relocation or removal of any existing structures, operation/closure/restoration of borrow areas, waste rock and storage areas, and if required, the construction and operation of rest areas and weigh stations.



The scope of the Project does not include consideration of the following (Appendix A):

- decommissioning (with the exception of temporary structures during construction) of the highway as this is not currently contemplated;
- the transportation of personnel or materials to the Project location for either construction or operation; and
- the manufacture of Project materials (e.g., culverts, pre-cast bridge elements, etc.) that are manufactured at existing facilities that exist or operate irrespective of this Project.

It should be noted that any decommissioning/abandonment activities would be subject to future examination under the *CEAA*, as appropriate. However, there are no plans for these activities, and therefore are not part of the Project.

4.2.2.2 Scope of the Assessment

The scope of the factors that were considered/assessed in relation to the Project was determined by Transport Canada and Fisheries and Oceans Canada pursuant to Section 16(3) of the *CEAA*, and is included in the Guidelines (Appendix A). The scope of the assessment was based on issues raised by the public, government departments and agencies, other interested parties and stakeholders, as well as the professional judgement of NBDOT and Jacques Whitford, ADI and AGFOR ("Study Team"). The issues scoping process focused the environmental assessment on components of the environment (biophysical, socio-cultural, and economic) that are valued by society, termed Valued Environmental Components or VECs. The Guidelines provided a preliminary list of VECs/issues of concern that should be considered in the environmental assessment. The Study Team expanded the suggested list to address additional issues raised during consultation, and to reflect the professional opinion of the Study Team. Section 4.2.3 presents the final list of VECs that were assessed for this CSR.

As stated in the Guidelines, to the extent that is possible, the discussion of these environmental effects and their proposed mitigation has given full consideration to community knowledge of the environment and of appropriate and effective mitigation measures.

The environmental assessment boundaries (*i.e.*, spatial, temporal and administrative boundaries) included the Project footprint, zones of influence, and schedule as well as the distribution of the affected population in time and space. The boundaries are defined for each VEC.

4.2.3 Selection of Valued Environmental Components for Environmental Effects Analysis

Considering the issues identified during the scoping process, the Study Team identified eleven (11) VECs. The relationship between VECs and the issues identified during the scoping process that were assessed is illustrated in Table 4.2.3.



Table 4.2.3 Valued Environmental Components Proposed for the CSR

VECs Suggested in the Guidelines	List of VECs Assessed in the CSR	Issues That Were Considered Within the Overall VEC Recommended by JWEL
Fish and Fish Habitat	Fish and Fish Habitat	- Fish and fish habitat - Navigable waters
Moose and Moose Habitat; Migratory Birds; Animal Species of Special Conservation Concern	Wildlife	- Ungulates (including Moose) and their habitat - Migratory birds - Rare animal species
Plant Species of Special Conservation Concern; Appalachian Hardwood Forest	Vegetation	- Rare plant species - Appalachian Hardwood Forest
Wetlands	Wetlands	Wetland functional attributes and significance (note, rare plant considerations are addressed above)
Atmospheric Quality	Atmospheric Environment	- Noise - Air quality including gaseous and particulate emissions - Greenhouse gas emissions and global climate change - Local climate effects (microclimate and meteorology) - Weather patterns as they relate to construction, operation, and maintenance, including extreme conditions
Water Quality	Surface Water	- Hydrology - Flooding - Water quality and quantity, including road salt loadings and effects - Acid rock drainage - Sensitive slopes and stream banks - Areas of instability and flood zones
	Groundwater	- Bedrock geology and hydrogeology including potentially acid generating rock - Water wells - Groundwater contamination - Change in groundwater quantity
Agricultural Land	Land Use	- Forest resources - Agricultural land - Residential or commercial use of land - Recreational use of land - Dumps and landfills, sewage discharges - Environmentally sensitive or protected areas, special or sensitive landform features
N/A	Labour and Economy	- Social, economic and cultural setting of the project area - Population and community distribution - Local, regional and provincial economy - Agriculture - Forestry and forest inventory - Tourism and recreation, including use of wildlife species of recreational or commercial value, and Appalachian Trail.
N/A	Heritage and Archaeological Resources	- Archaeological Resources - Architectural and other heritage resources
N/A	Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons	Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

These VECs were selected by the Study Team based on their professional judgement to reflect the nature of the issues and concerns, the Project, and the receiving environment. This provided an appropriate context for the efficient analysis of the environmental effects. The specific rationale for the selection of each VEC is presented in the introduction of the VEC sections in Section 5.0.

The CSR also includes an analysis of the potential effects of the environment on the Project.





5.0 ENVIRONMENTAL ASSESSMENT

5.1 Atmospheric Environment

5.1.1 Rationale for Selection as Valued Environmental Component

The Atmospheric Environment is the component of the environment that comprises the layer of air near the earth's surface to a height of approximately 10 km. The Atmospheric Environment is typically characterized by climate, air quality and sound quality (noise). In the context of this EA, Atmospheric Environment is defined as the chemical and physical attributes of air and climate including, but not limited to, gaseous and atmospheric particulate emissions (dust), and noise.

The Project may result in noise and the release of various contaminants to the Atmospheric Environment. These vary depending on the Project activity (e.g., potential noise and dust during the construction activities; and gaseous emissions during operation).

The Atmospheric Environment has been selected as a VEC not only due to the nature of potential Project-related atmospheric emissions, but also because of its intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. The Atmospheric Environment is an important pathway that could transport contaminants or transfer environmental effects to the freshwater, terrestrial and human environments.

This EA focuses on key aspects of the VEC as presented in Table 5.1.1. These aspects have been selected on the basis of consideration of the Project description (Chapter 3) and those Project-related emissions that are considered to be substantive.

Table 5.1.1 Key Aspects and Issues of Atmospheric Environment

Aspects of VEC on which the EA Focused	Issues Considered
Air Quality	• Air quality including gaseous and particulate emissions • Greenhouse gas emissions and global climate change
Climate	• Local climate environmental effects (microclimate and meteorology) • Weather patterns as they relate to highway construction, operation, and maintenance, including extreme conditions
Sound Quality	• Sound pressure levels, frequency and duration of noise producing activities



5.1.2 Environmental Assessment Boundaries

5.1.2.1 Spatial and Temporal

The spatial boundaries for the assessment of the atmospheric environment consist primarily of the area of disturbance associated with the Project. Project related environmental effects on air quality are generally not expected to extend beyond approximately 300 m of the RoW (Figure 3.2A-D, Appendix C). The 300 m range is generally sufficient for the dispersion of emissions from vehicle traffic and the dissipation of noise generated from heavy equipment operations. For greenhouse gases, the boundary is extended to include the Province of New Brunswick in the context of national and international emissions.

The temporal boundaries of the Project include periods of construction, and subsequent operation and maintenance of the Project in perpetuity.

5.1.2.2 Administrative and Technical

The technical factors for the Atmospheric Environment VECs pertain mainly to regulatory limits with respect to the release of air contaminants of concern to the ambient environment. These standards are set by regulatory authorities to reflect environmental protection objectives with the intent of being protective of air quality as well as human and environmental health.

Air Quality

Air quality will be assessed in the context of project related emissions and ground-level concentrations for the contaminants of interest. Project-related air quality contaminants of interest include:

- particulate matter (PM; total suspended particulate (TSP); and dust);
- particulate matter less than 10 microns (PM_{10});
- particulate matter less than 2.5 microns ($PM_{2.5}$);
- sulfur dioxide (SO_2);
- nitrogen oxides (NO_x);
- carbon monoxide (CO); and
- carbon dioxide (CO_2).

Since the Project will not result in measurable emissions of greenhouse gases other than CO_2 , such as methane or nitrous oxide, effects from these gases are not expected to be substantial and are therefore not considered further in this assessment.



The National Ambient Air Quality Objectives and the New Brunswick Maximum Permissible Ground Level concentrations for specified contaminants of interest are presented in Table 5.1.2 for reference and comparison with measured data.

The maximum acceptable levels, above which immediate action should be taken to protect air quality, are also provided in Table 5.1.2 for comparison. There are no New Brunswick or national objectives or standards for PM₁₀ (i.e., Particulate Matter < 10 µm), and therefore values adopted by the Greater Vancouver Regional District and the optional values originally proposed in the 1998 Accord for PM₁₀ are provided for comparison. The Canada Wide Standard for PM_{2.5} (i.e., Particulate Matter < 2.5 µm) for a 24-hour averaging period, to be achieved based on the 98th percentile measurement annually, averaged over three consecutive years, is also provided in Table 5.1.2. It should be noted that this latter standard does not come into effect until the year 2010.

Table 5.1.2 Canadian and New Brunswick Ambient Air Quality Objectives

Contaminant	Averaging Period	New Brunswick Maximum Permissible Ground Level Concentration for Acceptable Air Quality ¹ (µg/m ³)	National Ambient Air Quality Objectives, Maximum Desirable/Acceptable Levels ² (µg/m ³)
Total Suspended Particulate Matter	24-hr Annual	120 70*	- / 120 60 / 70
PM ₁₀	24-hr ^{3,4} Annual ⁴	- -	50 30
PM _{2.5}	24 hr ⁵	-	30
SO ₂	1-hr 24-hr Annual	900 300 60	450 / 900 150 / 300 30 / 60
NO _x (As NO ₂)	1-hr 24-hr Annual	400 200 100	- / 400 - / - 60 / 100
CO	1-hr 8-hr	35,000 15,000	- -

Notes:

* = geometric mean

1. Clean Air Act for New Brunswick (1997) Air Quality Regulation, Schedule B – Maximum Permissible Ground Level Concentrations in Micrograms per Cubic Metre at Standard Conditions of 21°C and 101.3 kPa.
2. Canadian Environmental Protection Act, Clean Air Act, Ambient Air Quality Objectives Order, No. 1, Schedule 1.
3. Greater Vancouver Regional District (2001)
4. CCME (1998)
5. CCME (2000)

Sound Quality

Outdoor sound quality can be influenced by vehicle traffic and operation of heavy equipment such as bulldozers, trucks, or diesel generators, and by weather conditions such as temperature, humidity, wind direction and wind speed. Local topographical features such as hills or wooded areas may serve to attenuate sound levels. There may be sound reflections if the atmospheric mixing height is low (a few hundred metres), or if solid structures are located near the source of noise emissions.



Outdoor noise may be defined as unwanted sound and is often present at several different frequencies. The audible frequencies for humans are in the range 500-20,000 Hertz (Hz). The sound level pressure level or noise level is measured in decibels on three different scales: A, B and C. The A-weighted scale is generally used for most sound measurements, since it discriminates against frequencies less than 600 Hz, and measures sound levels which come closest to approximating risk of hearing damage in humans. Measured sound parameters are generally expressed as an "equivalent sound level" (L_{eq}) over a specified period of time (e.g., 1 hour or 24 hours).

Regulatory Limits for Sound Quality

More general requirements from the Province of New Brunswick take the form that noise from any process must be controlled such that it does not cause substantial loss of enjoyment of the normal use of any property, or cause substantial interference with the normal conduct of business. In some cases, the hours of operation of a noise source may be restricted with a higher limit such as 65 decibels on the A-weighted scale (dB_A) for one period and another value such as 55 dB_A for another period during the same day. The noise from an operation may also be limited to a level that is less than 10 dB_A over the natural background measured as a 1-hour L_{eq} . While noise is defined as an air contaminant in the *Clean Air Act*, no specific noise guideline currently exists in New Brunswick. However, requirements stated in recent Certificates of Approval to operate from the NBDELG have included a maximum noise level of 55 dB_A at facility boundaries. Noise threshold values established in other jurisdictions and in the United States specifically for roadways vary from 55 to 70 dB_A and may be 1 hour or 24 hour standards. In the state of Maine, the threshold is established as an increase of 15 dB_A over existing noise levels. For the purpose of this assessment, the NBDOT guideline of 65 dB_A (24-hour L_{eq}) at Noise Sensitive Areas (NSAs) will be used (ADI Limited 2003).

Model Validation

In the assessment of the potential effects of the operation of the proposed TCH on sound quality, noise modelling is conducted to predict the sound pressure levels at NSAs near the proposed highway. Noise sensitive areas are those locations such as residences or areas near residences that may be sensitive to changes in noise before and after the highway construction is completed. The modelling is conducted using the Federal Highway Administration Traffic Noise Model (FHWA-TNM, Version 2.0) combined with local data on terrain, vegetation, traffic volumes and traffic composition in terms of the fraction of vehicles that are heavy trucks.

To ensure a high degree of accuracy in the model predictions used in this Environmental Assessment, model validation was conducted at eleven locations along existing roadways near the proposed TCH. The selection of the noise validation measurement locations was based on the proximity of receivers to the Project and the existence of a clear line of sight to the existing roadway. Validation measurement was



conducted immediately adjacent to the roadways to ensure that only noise generated as a result of traffic on the roadways was measured. The locations and time of the measurement are presented in Table 5.1.3. The measurement locations are also presented graphically in Figures 3.2-A to 3.2-D.

Table 5.1.3 Noise Measurement Locations for Model Validation Purposes

Location for Model Validation Measurement	Latitude	Longitude	Date	Start Time	Stop Time
Beaconsfield Road	46° 42' 18.3"	67° 44' 24.9"	August 11, 2003	05:37 PM	06:42 PM
Bowmaster Flats	46° 40' 56.5"	67° 43' 41.7"	August 11, 2003	04:12 PM	05:17 PM
Route 560 Site B	46° 35' 33.0"	67° 44' 41.9"	August 8, 2003	03:41 PM	04:46 PM
B Smith Road	46° 31' 57.9"	67° 42' 11.1"	August 8, 2003	02:06 PM	03:11 PM
Backland Road	46° 29' 40.9"	67° 40' 25.2"	August 8, 2003	12:40 PM	01:48 PM
Sipprell Road	46° 28' 00.2"	67° 40' 04.1"	August 28, 2003	05:55 PM	06:57 PM
Route 110	46° 26' 24.9"	67° 39' 05.6"	August 8, 2003	09:26 AM	10:32 AM
Raymond Road	46° 19' 01.6"	67° 35' 19.4"	July 31, 2003	5:06 PM	5:50 PM
Estey Road	46° 16' 21.2"	67° 35' 19.7"	July 31, 2003	11:06 PM	12:06 PM
Palmer Road	46° 15' 03.2"	67° 36' 07.2"	July 31, 2003	11:33 AM	12:39 PM
Route 560 Site A	46° 11' 55.9"	67° 36' 36.3"	July 31, 2003	10:11 AM	11:14 AM

The 1-hour L_{eq} measured at each location was compared to the noise model prediction, which in turn was based on the traffic volumes observed during the noise monitoring events. The lower limit of human perception of a change in sound level is 3 dB_A . The results of the model validation are presented in Table 5.1.4. Overall, the model predictions are in good agreement with the measured values. For those predictions above 3 dB_A , estimates are conservative (*i.e.*, higher than measured). Therefore, the noise model is capable of providing a reasonably representative prediction of noise due to nearby vehicle traffic.

Table 5.1.4 Noise Model Validation

Noise Sensitive Area Monitor Location	Measured L_{eq} (dB_A)	Modelled L_{eq} (dB_A)	Difference L_{eq} (dB_A)
Estey Road	59.4	54.9	-4.5
Palmer Road	55.7	52.7	-3.0
Raymond Road	56.9	56.0	0.9
Route 560 Site A	64.3	60.6	-3.7
Route 110	62.2	59.5	2.7
Sipprell Road	53.7	51.4	-2.3
Backland Road	49.6	47.1	-2.5
B Smith Road	54.3	57.2	+2.9
Route 560 Site B	57.1	54.2	-2.9
Bowmaster Flats	66.0	70.3	+4.3
Beaconsfield Road	51.6	48.9	-2.7

M.L. = Monitor Location



5.1.3 Criteria for Establishing Threshold of Significance

A *significant residual environmental effect* on Air Quality is one that degrades the quality of the air such that the maximum Project-related ground-level concentration of the contaminants of concern (PM, SO₂, NO_x, and CO) leads to the exceedance of the ambient air quality standards.

In the absence of specific regulatory guidance on CO₂ emissions or ambient CO₂ concentrations, a *significant residual environmental effect* on Air Quality in terms of greenhouse gas emissions for this EA is considered to be a substantive increase to provincial releases (*i.e.*, >1% of total Provincial CO₂ emissions). This is in itself a conservatively set threshold as climate change is a global phenomenon to which New Brunswick is a small contributor in the national and global contexts.

A *significant residual environmental effect* with respect to Sound Quality may be defined as a noticeable change in noise level (an average of approximately 10 dB_A above background) over a sustained period (24-hour), or a frequent exceedance of the noise guideline level at an NSA ("Frequent" is defined as 1 day per month of 12 days per year). In the absence of official regulatory guidelines in New Brunswick for ambient noise, the current NBDOT noise limit of 65 dB_A (24-hour L_{eq}) will be used as the noise guideline level (ADI Limited 2003).

5.1.4 Existing Conditions

5.1.4.1 Climate

The climate of New Brunswick is typically continental. The proposed TCH will be located in a largely rural area 200 km or more inland from the Gulf of St. Lawrence and the North Atlantic Ocean. The area experiences a continental climate with large temperature swings with the seasons; cold with substantial snowfall in the winter and warm with high relative humidity in the summer.

The description of the climate for the Project is based upon climate normals from four Environment Canada weather stations located in the vicinity of the proposed project. These climate data are presented for each of the four weather stations, Woodstock, Aroostook, Saint-Léonard, and Grand Falls, in Tables 5.1.5 to 5.1.8, respectively. The weather data from these sites are considered to be an accurate representation of average weather conditions in the vicinity of the proposed TCH.



Table 5.1.5 Monthly Climate Normals – 1971-2000
Woodstock, New Brunswick
 Long 46° 09' N Lat 67° 35' W, Elevation 153 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	13.3	16.5	23.9	31.5	35.6	35.6	36.7	39.4	34.4	30.0	22.8	16.1	--
T mean max (C)	-5.7	-3.3	2.4	9.3	18.1	22.8	25.5	24.6	19.1	11.9	4.6	-2.7	10.5
T mean min (C)	-17.2	-16.0	-8.8	-1.9	4.5	9.9	13.0	12.0	7.0	1.1	-3.9	-12.5	-1.1
T extreme min (C)	-43.5	-43.9	-37.2	-23.3	-9.4	-6.7	-1.1	-1.0	-6.7	-13.3	-25.0	-40.6	--
T daily mean (C)	-11.5	-9.7	-3.2	3.7	11.3	16.4	19.3	18.3	13.1	6.5	0.4	-7.6	4.8
Mean Precip (mm)	107.3	67.5	91.9	77.0	94.5	98.0	92.0	96.0	95.7	92.0	96.9	104.9	1113.5
Mean Snow Fall (cm)	74.4	48.5	53.6	20.6	0.5	0.0	0.0	0.0	0.1	2.7	21.6	56.7	278.9
Mean # days with Measurable Precipitation	11.3	9.1	11.0	11.0	12.3	11.8	11.3	11.1	10.7	10.8	11.8	12.7	134.8

Environment Canada 2002a.

Table 5.1.6 Monthly Climate Normals – 1971-2000
Aroostook, New Brunswick
 Lat 46° 48' N, Long 67° 53' W, Elevation 91 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	14.5	13.5	23.9	29.5	34.0	36.1	35.6	37.2	32.8	29.4	21.1	16.1	--
T mean max (C)	-6.7	-4.4	1.8	8.9	17.4	22.5	24.9	23.7	18.3	11.2	3.8	-3.5	9.8
T mean min (C)	-18.3	-17.2	-9.6	-2.0	4.4	9.7	12.7	11.6	7.1	1.4	-4.0	-13.2	-1.4
T extreme min (C)	-43.9	-42.2	-36.7	-22.2	-11.1	-2.8	1.7	-0.6	-6.7	-13.9	-23.3	-42.8	--
T daily mean (C)	-12.5	-10.8	-3.9	3.5	10.9	16.1	18.8	17.7	12.7	6.4	-0.1	-8.3	4.2
Mean Precip (mm)	99.6	65.6	81.5	77.7	92.5	90.2	107.4	102.0	89.2	86.0	93.7	100.9	1086.3
Mean Snow Fall (cm)	72.0	51.4	52.3	24.1	0.6	0.0	0.0	0.0	0.1	2.9	31.8	63.6	298.8
Mean # days with Measurable Precipitation	12.3	9.8	12.9	13.2	13.5	12.0	13.5	12.1	11.1	12.7	12.6	13.5	149.2

Environment Canada 2002a.

Table 5.1.7 Monthly Climate Normals – 1971-2000
Saint-Léonard, New Brunswick
 Long 47° 09' N Lat 67° 49' W, Elevation 243 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	11.7	14.4	17.7	28.1	34.6	32.7	34.2	34.6	31.2	23.7	18.7	12.7	--
T mean max (C)	-7.0	-5.8	0.7	7.8	16.6	21.5	23.8	22.7	17.4	10.2	2.4	-4.4	8.8
T mean min (C)	-18.4	-17.8	-10.3	-2.5	3.5	8.5	11.6	10.4	5.6	0.3	-5.9	-13.9	-2.4
T extreme min (C)	-36.8	-33.4	-33.6	-18.3	-5.6	-2.5	3.3	1.5	-6.3	-9.6	-23.2	-32.6	--
T daily mean (C)	-12.7	-11.8	-4.8	2.7	10.1	15.1	17.8	16.6	11.5	5.3	-1.7	-9.2	3.2
Mean Precip (mm)	115.2	64.6	74.0	77.8	88.6	97.0	111.6	109.3	95.0	93.8	85.0	79.8	1091.5
Mean Snow Fall (cm)	95.3	63.1	56.9	28.6	2.9	0.0	0.0	0.0	0.1	6.3	35.6	64.8	353.5
Mean # days with Measurable Precipitation	18	12.4	13.9	13.8	14.9	14.3	14.3	14.4	13.9	15.6	15.1	14.7	175.1

Environment Canada 2002a.



Table 5.1.8 Monthly Climate Normals – 1971-2000

Grand Falls Drummond, New Brunswick

Long 47° 02' N Lat 67° 42' W, Elevation 229 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	10.5	11.5	16.0	27.5	33.0	33.9	33.5	32.8	29.5	25.6	18.0	13.9	
T mean max (C)	-8.3	-5.9	0.1	7.1	16.2	20.9	23.3	22.2	16.6	9.7	2.2	-5.3	8.2
T mean min (C)	-17.7	-15.6	-9.5	-1.7	5.0	9.9	12.8	11.8	6.7	1.9	-4.3	-13.7	-1.2
T extreme min (C)	-36.7	-35.6	-38.0	-18.5	-7.8	0.0	2.8	0.0	-4.0	-9.4	-22.0	-34.0	
T daily mean (C)	-13.0	-10.8	-4.6	2.7	10.6	15.4	18.1	17.0	11.7	5.8	-1.1	-9.5	3.5
Mean Precip (mm)	94.4	65.8	81.5	77.5	86.2	101.2	117.5	126.8	99.6	91.3	92.1	100.8	1134.4
Mean Snow Fall (cm)	71.6	55.1	47.0	24.8	0.7	0.0	0.0	0.0	0.0	1.8	31.1	67.9	300.1
Mean # days with Measurable Precipitation	11.1	9.7	11.6	12.8	13.3	14.5	14.3	14.4	13.2	13.0	12.6	13.4	153.8

Environment Canada 2002a.

The climate data for all four sites are very similar. This similarity is expected since the sites are located relatively close together and in similar landscapes and climate differences are small and would be due to potential microclimate effects at these sites.

During the winter, the air mass is often cold and unaltered with an average daily temperature of -12.3°C in January. During the summer, the air mass is predominantly warm continental with an average July daily mean temperature of 18.5°C. The extreme maximum and minimum temperatures recorded in the region are 39.4°C and -43.9°C, respectively.

The average annual precipitation in the vicinity of the Project is 1099.9 mm, of which approximately 79% is in the form of rain. The frequency of precipitation is fairly consistent throughout the year, with peak amounts generally occurring during the months of July, August, September, December, and January.

The proposed TCH runs through many areas containing hills and valleys. Due to the potential for local terrain induced effects on wind patterns (wind speed and direction), a graphical presentation of the prevailing wind direction and velocity could vary highly depending on the site selected. For areas located in valleys, the prevailing wind direction is commonly along the valley.

Differences in wind patterns by geographic location, along the general traverse of the proposed project RoW (from north to south), are demonstrated in the wind rose plots for Saint-Léonard, New Brunswick, Caribou, Maine and Fredericton, New Brunswick (Figures 5.1.1 to 5.1.3, respectively). In all cases there is a substantial component from the northwest and the wind blows most frequently from the westerly directions. The average wind speed at the sites is 3.67 m/s, 4.08 m/s and 3.54 m/s, respectively. These values are representative of conditions within the vicinity of the Project.



5.1.4.2 Ambient Air Quality

The Province of New Brunswick, through the NBDELG, has been operating a network of ambient air monitoring stations within the province to measure air quality parameters in real time mode. Not all sites measure all pollutants, however the data presented for various monitoring locations are considered to be the most representative for the proposed TCH, where PM, PM₁₀, PM_{2.5}, SO₂, and NO_x were monitored. The monitoring stations considered in the analysis to establish existing conditions for the project are listed below:

- Fredericton (York Street);
- Fredericton (Aberdeen Street);
- Nackawic;
- Canterbury;
- Saint-Léonard;
- Edmundston (Cormier); and
- Edmundston (Sacred Heart).

More detail on the air quality monitoring stations, the pollutant types and specific monitoring locations may be found in the annual publication by the NBDELG (2003a) and NBDOE in previous years (NBDOE 1999a, b, 2000) (the acronyms NBDELG and NBDOE are synonymous with the provincial Department of the Environment).

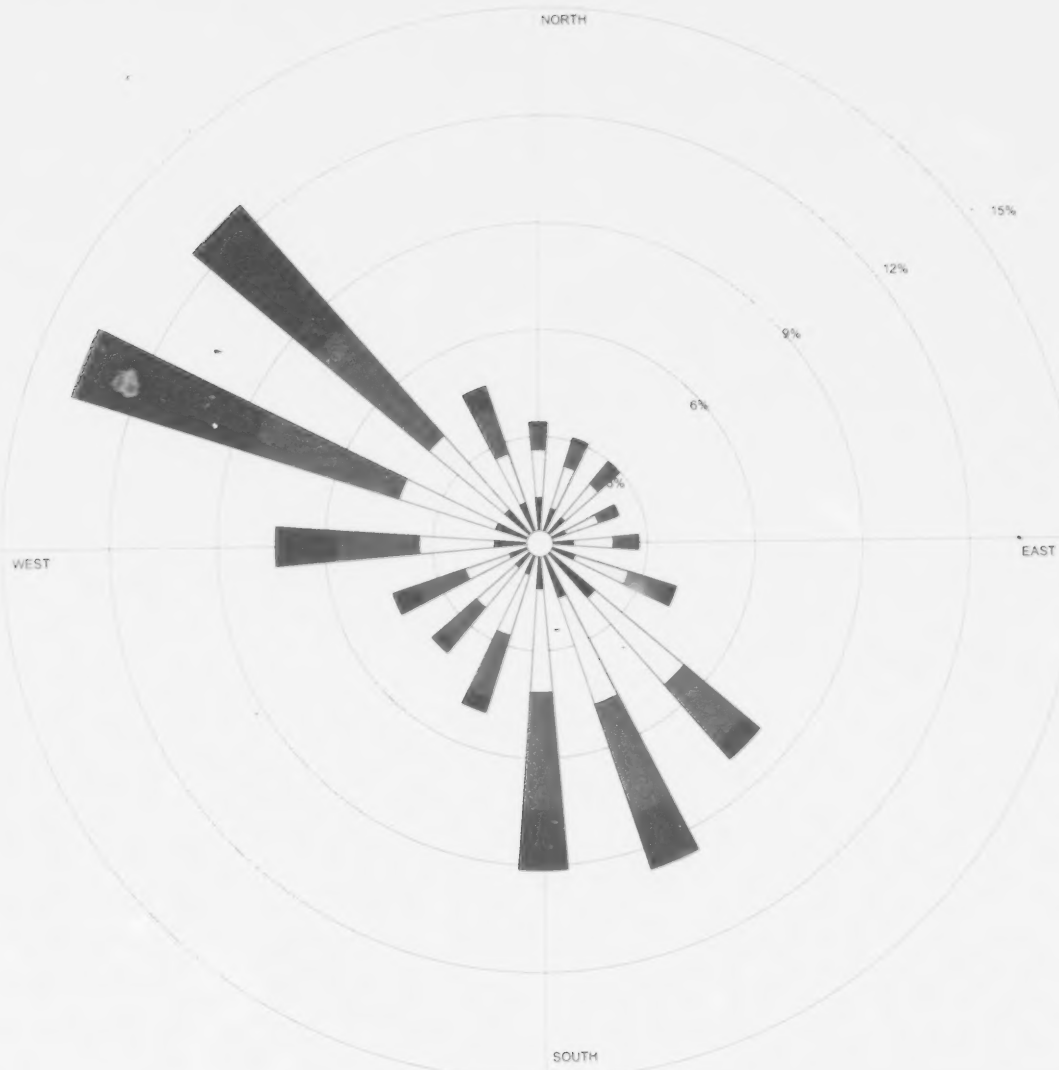
The Environmental Protection Service of Environment Canada (EPS) is responsible for the operation of several ambient air quality monitors across Canada. This network is referred to as the National Air Pollution Surveillance or NAPS network. The data from these monitoring activities is provided in summary reports published annually (Environment Canada 1998, 1999a, b, 2000, 2001a, b, 2002b).

The ambient air quality monitoring network in New Brunswick is operated cooperatively by Environment Canada and the NBDELG. Both agencies produce annual reports with detailed summaries of the measured data recorded each year. The reports differ in the presentation of the data. Environment Canada presents the data in percentile format with no interpretation while the NBDELG presents data summaries of means, trends and some interpretation of results. For this reason it is useful to provide a review of both sets of reports.





WIND ROSE PLOT
ST. LEONARD, NEW BRUNSWICK



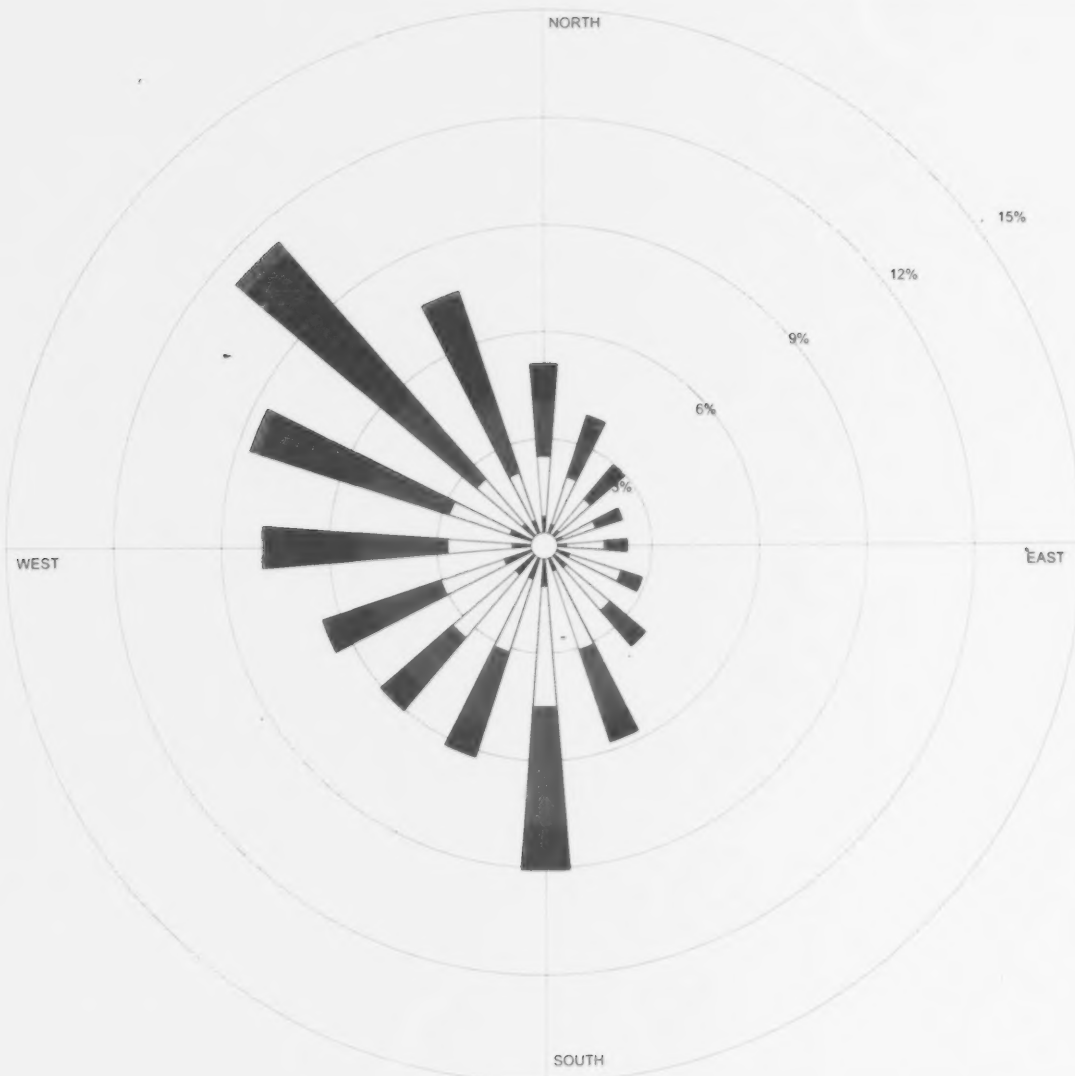
Wind Speed (m/s)	MODELER ECS	DATE 7/6/03	COMPANY NAME Jacques Whitford Environment Ltd.
	DISPLAY Wind Speed	UNIT m/s	COMMENTS Meteorological Data St. Leonard Airport 1986-1990
	AVG. WIND SPEED 3.67 m/s	CALM WINDS 2.91%	
	ORIENTATION Direction (blowing from)	PLOT YEAR, DATE-TIME 1986 Jan 1 - Dec 31 Midnight - 11 PM	PROJECT/PLOT NO Figure 5.1.1

WINDPLOT, v. 1.03 by Lakes Environmental Software - www.lakes-environmental.com





WIND ROSE PLOT
CARIBOU, MAINE



Wind Speed (m/s)	MODELER MRS	DATE 1/19/01	COMPANY NAME Jacques Whitford Environment Ltd.
	DISPLAY Wind Speed	UNIT m/s	COMMENTS Meteorological Data 1985-1989
	AVG. WIND SPEED 4.08 m/s	CALM WINDS 7.95%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1985 Jan 1 - Dec 31 Midnight - 11 PM	PROJECT/PLOT NO. Figure 5.1.2

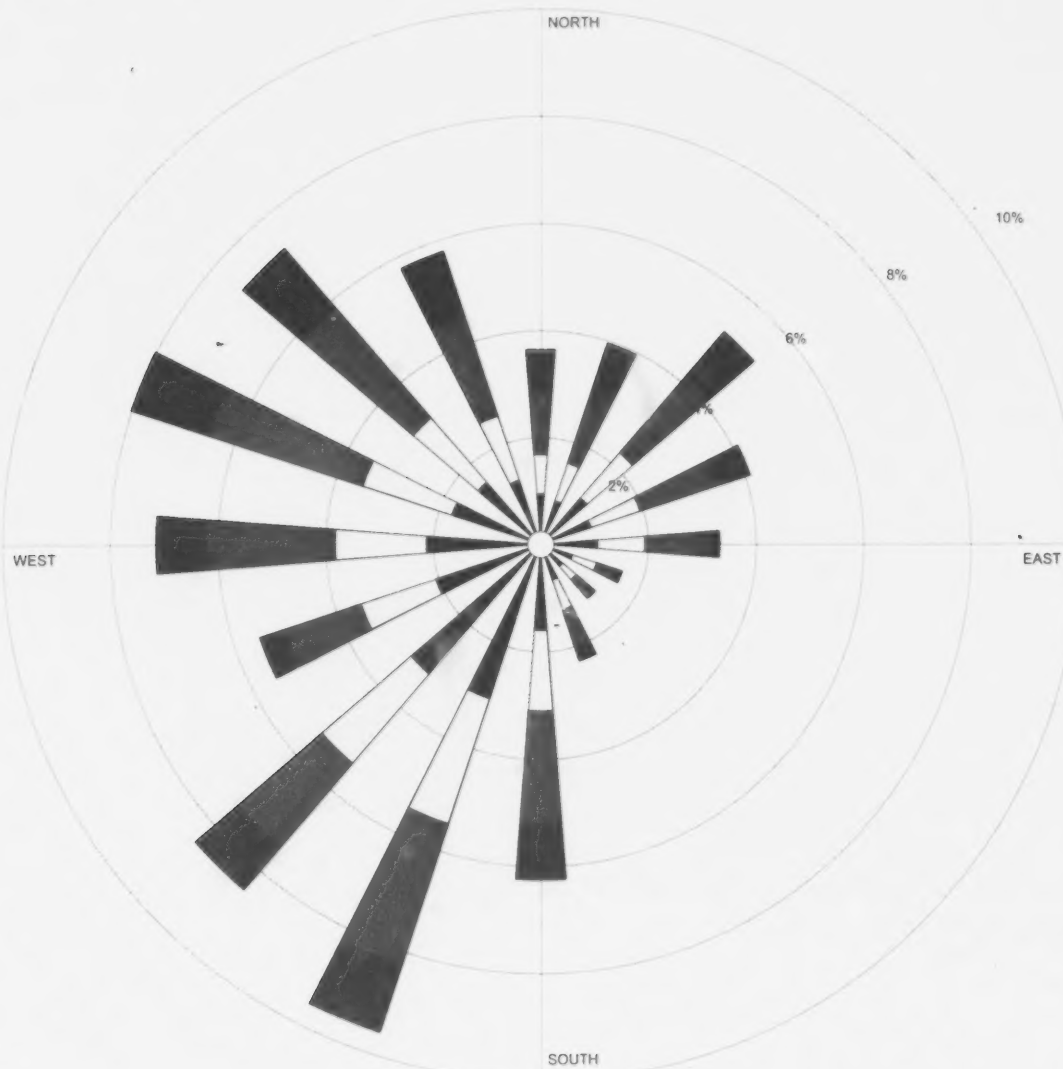
WARPLOT ver. 3.05 by Lakes Environmental Software - www.lakes-environmental.com



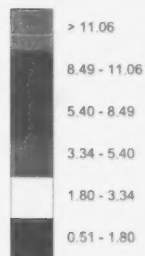


WIND ROSE PLOT

FREDERICTON, NEW BRUNSWICK



Wind Speed (m/s)



MODELER

MRS

DATE

3/6/01

COMPANY NAME

Jacques Whitford Environment Ltd.

DISPLAY

Wind Speed

UNIT

m/s

COMMENTS

Meteorological Data
Fredericton Airport
1995-2000

AVG. WIND SPEED

3.54 m/s

CALM WINDS

16.45%

ORIENTATION

Direction
(blowing from)

PLOT YEAR-DATE-TIME

1995
Jan 1 - Dec 31
Midnight - 11 PM

PROJECT/PLOT NO.

Figure 5.1.3



5.1.4.2.1 Trends – Short Term 1995-2001

The information on short term trends in ambient air quality was obtained from the NBDELG's annual air quality report for the year 2001 (NBDELG 2003a), and from Environment Canada's National Air Pollution Surveillance (NAPS) Network Annual Summary for 2000 (Environment Canada 2001a). The reader is referred to these reports for more detailed information. It should be noted that not all parameters are measured at all of the monitoring locations. However, all parameters of interest are measured at a minimum of one of the stations considered. Some highlights of these reports are presented below. A summary of the ambient monitoring data from 1995 to 2001 is presented in Table 5.1.9.

Particulate Matter

Particulate matter (PM, also referred to as Total Suspended Particulate matter or TSP) in general, tends to be present as a result of local emissions and is therefore a potential local environmental effect rather than a regional issue. Nonetheless, data are presented for values measured at NBDELG's Fredericton (York Street) and Edmundston monitoring sites.

Exceedances of the 24-hour standard ranged from 6-14 days per year over the 1996 to 2000 data set at the Cormier Site in Edmundston. Higher values measured at the Cormier site are attributed to road dust from heavy traffic, due to the location of the monitor. The Sacred Heart site in Edmundston averages one exceedance of the 24-hour standard per year in 2001.

Exceedances of the 24-hour standard ranged from 0 to 2 per year for 1996 to 1998. Particulate matter was not monitored at the Fredericton monitoring station. There were four exceedances reported on both 1999 and 2000 and are attributed to construction activities occurring near the monitoring station.

The particulate matter monitor at the Nackawic station was installed and operational in 2000. There have been no exceedances of the 24-hour or annual standards and measured concentrations were low.

The measured annual average concentrations of PM in Edmundston ranged from 31-55 $\mu\text{g}/\text{m}^3$ (1996-2000). The annual average concentration for Fredericton ranged from 26-60 $\mu\text{g}/\text{m}^3$ from 1995-2001. In all cases, the measured concentrations were below the provincial standards.

Respirable Particulate Matter ($\text{PM}_{2.5}$)

Respirable particulate or $\text{PM}_{2.5}$ was also monitored continuously in 1999 and 2000 at the province's Fredericton monitoring station located on Aberdeen Street. Available data is not sufficient for a full comparison with the Canada Wide Standard (30 $\mu\text{g}/\text{m}^3$ as a 24-hour average, over three years). However, there was one exceedance in 1999 for 19 hours. No exceedances were observed in 2000. The 98th percentile value for 2000 was 18.0 $\mu\text{g}/\text{m}^3$, which is lower than 22.7 $\mu\text{g}/\text{m}^3$ from 1999.



Sulfur Dioxide

Ambient SO₂ concentrations are based on provincial data for Edmundston and Nackawic (monitoring of sulfur dioxide is not conducted at the other stations considered in the assessment). Compliance of the 1-hour and 24-hour SO₂ standards, expressed as the total number of hours below the applicable standards was 99.98% (two exceedances of the 1-hour standard in 2000) for the Cormier site and 100% (no exceedances) at the Sacred Heart site in 2000. There were no exceedances of the annual standard in 2000. There were no exceedances of the 1-hour, 24-hour annual standards in 2001.

The Nackawic monitoring station was established in 1999. Compliance of the standard has been 100% from 1999 to 2001.

Nitrogen Dioxide

Ambient nitrogen dioxide (NO₂) concentrations are based on the data for Fredericton (monitoring of nitrogen dioxide is not conducted at the other stations considered). There were no exceedances of the 1-hour, the 24-hour or annual standards observed in the provincial data for Fredericton, for the period 1996-2000 inclusive.

The measured annual concentration of NO₂ has gradually decreased over the past few years with the data ranging from 13-18 µg/m³ over the 3-year period.

5.1.4.2.2 Trends Long-Term

Analysis of long-term trends has not been conducted as the monitoring stations considered for the assessment have been in operation for a relatively short time period and therefore data are not available to conduct a reliable trend analysis.



Table 5.1.9 Ambient Air Quality Monitoring Data 1995-2001
National Air Pollution Surveillance (NAPS) Network and NBDELG

	1995		1996		1997		1998		1999		2000		2001	
	Site F	Site G	Site F	Site G	Site F	Site G	Site F	Site G	Site F	Site G	Site F	Site G	Site F	Site G
SO₂ (µg/m³)														
(Maximum)														
1-hour	245	320	314	173	331	143	615	113	64	454	99	76	244	-
24-hour	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annual Mean	18	8	10	6	10	4	12	4	1	14	6	-1	12	-
Dataset (months)	12	12	12	12	12	12	12	12	12	12	5	12	12	-
NO₂ (µg/m³)														
(98 th percentile)														
1-hour														
24-hour														
Annual Mean														
Dataset (months)														
NO (µg/m³)														
(98 th percentile)														
1-hour														
8-hour														
Annual Mean														
Dataset (months)														
CO (µg/m³)														
(98 th percentile)														
1-hour														
8-hour														
24-hour														
Annual Mean														
Dataset (months)														
O₃ (µg/m³)														
(98 th percentile)														
1-hour	96	110	94	98	80	96	80	96	90	90	90	84	86	108
8-hour	-	108	90	96	77	92	77	92	84	88	88	80	82	102
24-hour	84	102	82	90	67	86	67	86	82	82	82	71	79	92
Annual Mean	57	67	51	57	35	53	35	53	49	51	52	39	49	57
Dataset (months)	12	7	8	12	8	12	8	12	11	12	8	12	11	10
PM/TSP (µg/m³)														
(90 th percentile)														
24-hour	49	53	81	113	65	63	99	85	105	25	104	78	20	-
Annual Mean	33	33	42	50	31	34	60	-	54	-	50	40	-	-
Dataset (months)	12	12	12	12	12	12	11	12	11	12	7	4	1	12
PM 2.5 (µg/m³)														
(98 th percentile)														
1-hour														
24-hour														
Annual Mean														
Dataset (months)														

Site A - York Street, Fredericton (NAPS + NBDELG) Site B - Aberdeen Street, Fredericton (NAPS) Site C - Nackawic (Nackawic Pulp and Paper) Site D - Canterbury (NAPS + NBDELG)
Site E - Saint-Leonard (NAPS) Site F - Cormier, Edmundston (Fraser Papers) Site G - Sacred Heart, Edmundston (Fraser Papers)

NOTE: Not all parameters are measured at all of the sites



5.1.4.3 Sound Quality

Outdoor sound quality near roadways during construction and operation can be influenced by vehicle traffic, by the operation of heavy equipment such as bulldozers, trucks, or diesel generators, by blasting, and by weather conditions such as temperature, humidity, wind direction and wind speed. Local topographical features such as hills or wooded areas may serve to attenuate sound levels. There may be sound reflections if the atmospheric mixing height is low (a few hundred metres), or if solid structures are located near the source of noise emissions. Sound from traffic may increase during wet weather due to increased tire noise.

The sound quality, represented by existing sound pressure levels at the RoW boundaries, is expected to be typical of a rural, relatively remote area. In order to characterize the sound quality in the Assessment Area, a baseline noise assessment was conducted. This consisted of measuring the sound pressure levels at eleven locations representative of NSAs such as areas near residential homes or buildings, along the proposed RoW and comparing these with typical regulatory threshold values.

NSA 1 – Beaconsfield Road

This noise sensitive area is a residence located along the Beaconsfield Road as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 15 m from the Beaconsfield Road, and approximately 880 m from the existing Route 2. The proposed TCH will be located approximately 200 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the Beaconsfield Road and 4210 vehicles per day on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 2 – Bowmaster Flats

This noise sensitive area is a residence located along the existing Route 2 as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 30 m from the existing Route 2. The proposed TCH will be located approximately 100 m from the residential property on the opposite side to the residence as the existing Route 2.

The AADT in this area is estimated to be 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.



NSA 3 – Route 560 Site B (River De Chute)

This noise sensitive area is a residence located along Route 560 as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 1,400 m from the existing Route 2. The proposed TCH will be located approximately 140 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for Route 560 and 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 4 – B Smith Road

This noise sensitive area is a residence located along the B Smith Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 15 m from the B Smith Road and approximately 2,000 m from the existing Route 2. The proposed TCH will be located approximately 130 m from the residential property on the opposite side to the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the B Smith Road and 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 5 – Backland Road

This noise sensitive area is a residence located along the Backland Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 7 m from the Backland Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 70 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the Backland Road and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 6 – Sipprell Road

This noise sensitive area is a residence located along the Sipprell Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 5 m from the Sipprell Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 300 m from the residential property on the same side of the residence as the existing Route 2.



The AADT in this area is estimated to be 1,000 vehicles per day for the Sipprell Road and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 7 – Route 110

This noise sensitive area is a residence located along Route 110 as shown on Figure 3.2-C. The noise meter was located west of the residence, approximately 8 m from Route 110 and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 150 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 3,080 vehicles per day for Route 110 and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 8 – Raymond Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-C. The noise meter was located west of the residence, approximately 5 m from the Raymond Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 370 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for the Raymond Road and 6530 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 9 – Estey Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-D. The noise meter was located near the residence, approximately 4 m from the Estey Road and approximately 1,000 m from the existing Route 2. The proposed TCH will be located approximately 120 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for Estey Road and 7960 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.



NSA 10 – Palmer Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-D. The noise meter was located west of the residence, approximately 5 m from the Palmer Road and approximately 1,000 m from the existing Route 2. The proposed TCH will be located approximately 200 m from the residential property on the opposite side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for Palmer Road and 8790 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 11 – Route 560 Site A

This noise sensitive area is a residence located along Route 560 as shown on Figure 3.2-D. The noise meter was located east of the residence, approximately 8 m from Route 560 and approximately 100 m from the existing Route 2. The proposed TCH will be located approximately 80 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,980 vehicles per day for Route 560 and 8790 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

Baseline Noise Assessment Results

Noise monitoring was conducted during the period of July 31 to August 11, 2003. Noise levels were measured at the locations using a Type 1 sound level meter (a Bruel & Kjaer Type 2236 and a Larson Davis System 824). Monitoring was conducted for one hour at each of the sites listed in Table 5.1.3 for model calibration purposes. Traffic counts and composition were also recorded. The measured data are considered to be representative of the sound level in the respective area. In addition, 24-hour sampling was conducted at two of the sites (Route 560 Site A, and B. Smith Road) in order to establish the variation over a full day. The 1 hour equivalent sound level (L_{eq}) values are presented in Table 5.1.10.

Table 5.1.10 Noise Monitoring Data Summary

Monitor Location	Date	Start Time	Stop Time	Total Traffic Flow (Vehicles)	% Heavy Trucks	Measured Noise Level L_{eq} (dB _A)
Beaconsfield Road	August 11, 2003	05:37 PM	06:42 PM	9	0	51.6
Bowmaster Flats	August 11, 2003	04:12 PM	05:17 PM	613	15.5	66.0
Route 560 Site B	August 8, 2003	03:41 PM	04:46 PM	25	4.0	57.1
B Smith Road	August 8, 2003	02:06 PM	03:11 PM	12	41.7	54.3
Backland Road	August 8, 2003	12:40 PM	01:48 PM	10	0	49.6
Sipprell Road	August 28, 2003	05:55 PM	06:57 PM	13	0	53.7



Table 5.1.10 Noise Monitoring Data Summary

Monitor Location	Date	Start Time	Stop Time	Total Traffic Flow (Vehicles)	% Heavy Trucks	Measured Noise Level L_{eq} (dB _A)
Route 110	August 8, 2003	09:26 AM	10:32 AM	177	19.2	62.2
Raymond Road	July 31, 2003	5:06 PM	5:50 PM	19	5.3	56.9
Estey Road	July 31, 2003	11:06 AM	12:06 PM	54	5.6	59.4
Palmer Road	July 31, 2003	11:33 AM	12:39 PM	9	11.1	55.7
Route 560 Site A	July 31, 2003	10:11 AM	11:14 AM	877	15.5	64.3

The values recorded at all locations demonstrate typical levels expected in rural areas and for the existing traffic volumes.

The results of the 24-hour monitoring conducted at the B. Smith Road and Route 560 Site A locations are presented graphically in Figures 5.1.4 and 5.1.5 respectively. At the time of monitoring, Route 560 had a more steady and larger traffic volume than the B Smith Road location, which is reflected in the trends presented where the Route 560 location (Figure 5.1.5) experienced levels near the guideline limit (hourly L_{eq} values between 60-63 dB_A during the day and 54-58 dB_A at night).

In both cases (24-hour L_{eq} values of 54 and 62 dB_A), the measurements did not exceed the NBDOT guideline of 65 dB_A (24-hour L_{eq}).

The data are representative of the existing conditions.



Figure 5.1.4 Noise Monitoring - 24 Hour Trend, B Smith Road

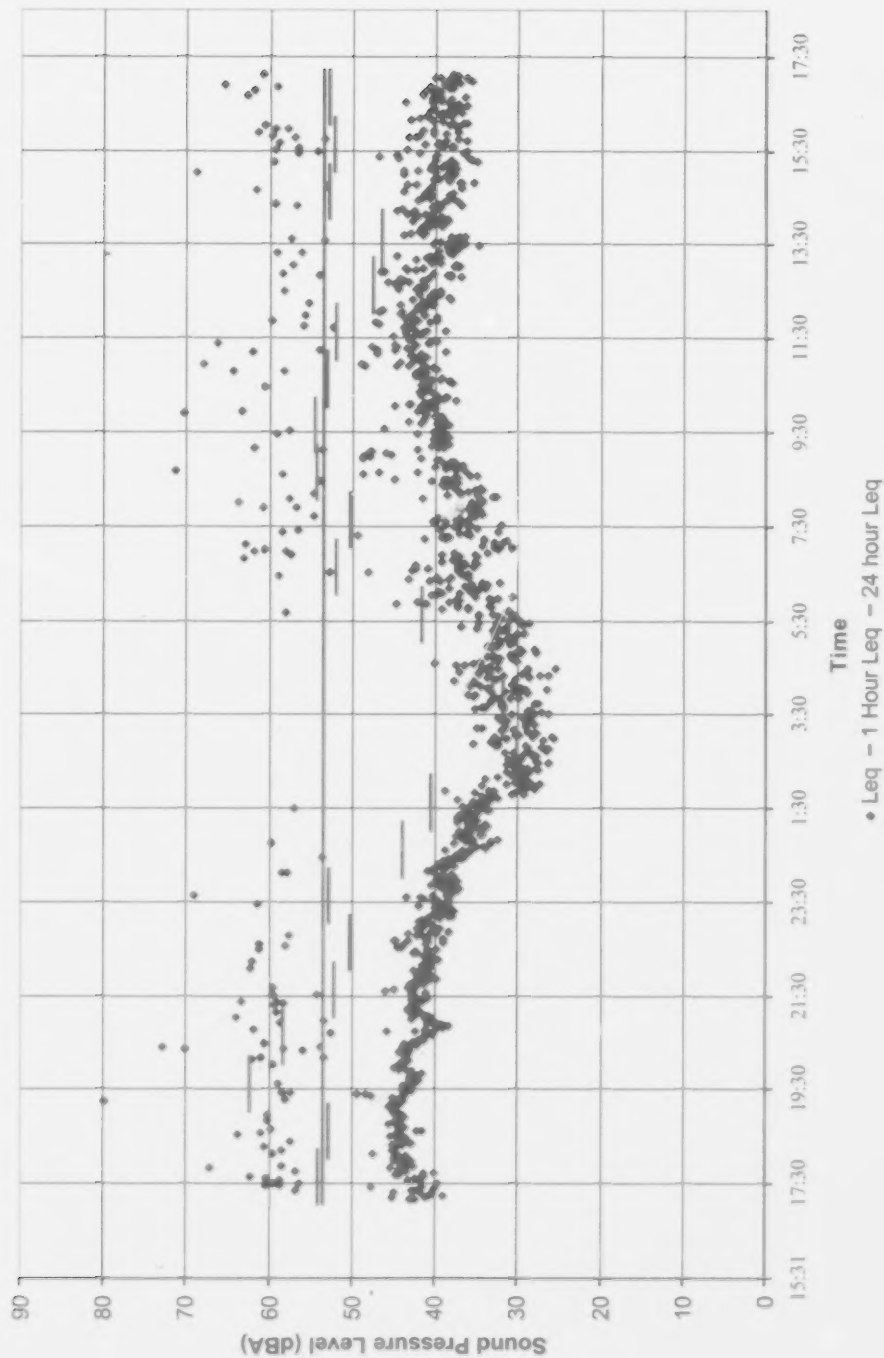
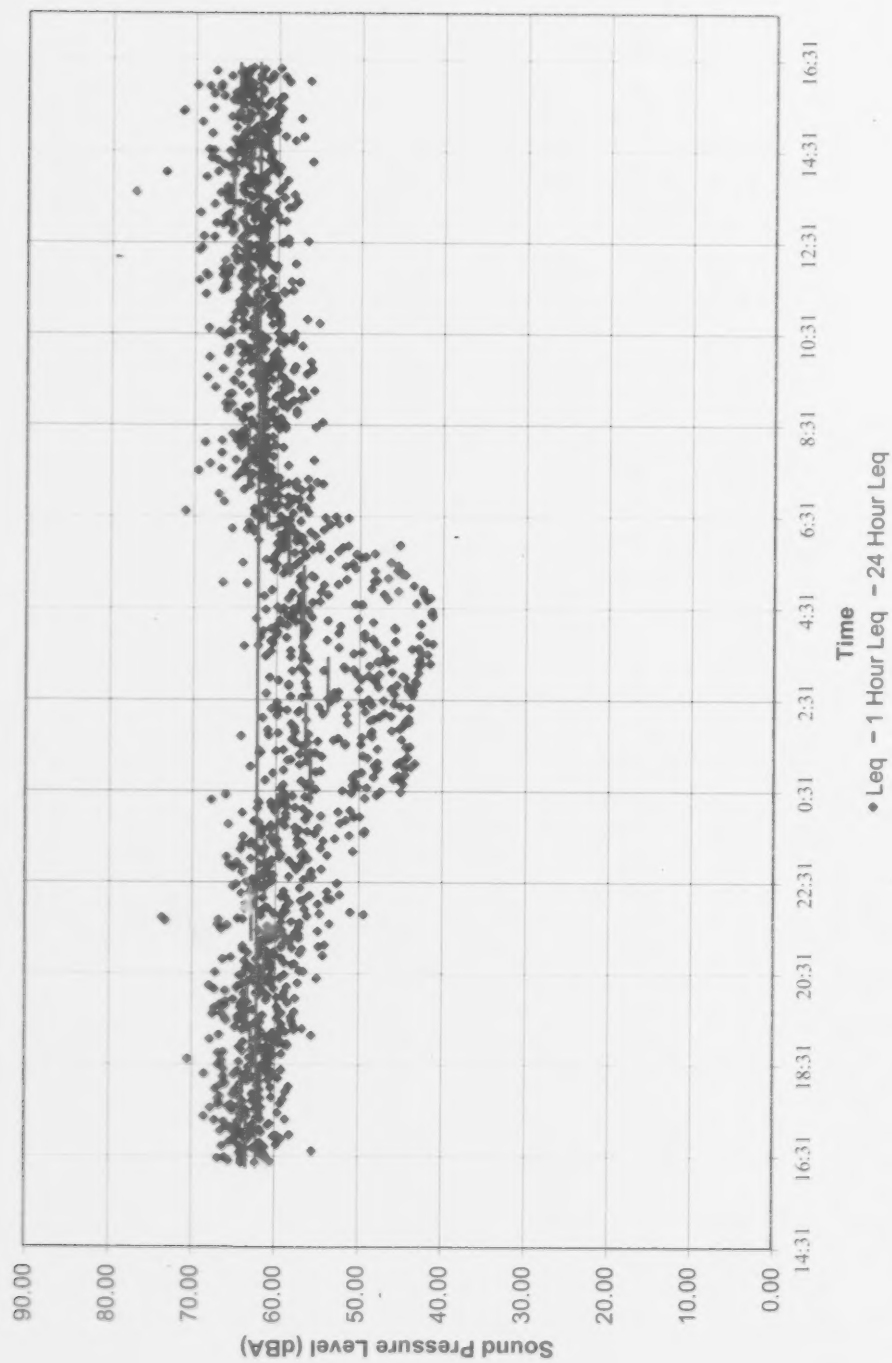




Figure 5.1.5 Noise Monitoring - 24 Hour Trend, Route 560





5.1.5 Environmental Effects Analysis

This section evaluates the significance of potential residual environmental effects resulting from the interaction of Project activities with the Atmospheric Environment. The proposed mitigation is included in the analysis.

5.1.5.1 Project-VEC Interactions

A summary of the potential environmental effects resulting from Project-VEC interactions, is provided in Table 5.1.11. The table is organized according to the various aspects of the VEC and each of the Project components assessed (*e.g.*, site preparation), as well as accidents, malfunctions and unplanned events.

Table 5.1.11 Project Activity – Environmental Effects Interaction Matrix for Atmospheric Environment

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u>			
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effect		
	Change in Air Quality	Change in Sound Quality	Change in Local Climate
Construction			
Site Preparation	✓	✓	
Roadbed Preparation	✓	✓	✓
Surfacing and Finishing	✓	✓	✓
Watercourse Crossing Structures	✓	✓	✓
Ancillary Structures and Facilities Construction	✓	✓	
Operation			
Winter Safety	✓	✓	
Proposed TCH Presence	✓	✓	
Maintenance			
Proposed TCH Maintenance	✓	✓	
Vegetation and Wildlife Management	✓	✓	
Accidents, Malfunctions and Unplanned Events			
Fires	✓	✓	

The data in Table 5.1.11 demonstrate that most Project activities will result in emissions to the atmosphere that will contribute to Project-related environmental effects on Air Quality. These are due to combustion gases and dust generated by project-related vehicles and equipment. All of the Project activities have some interaction with Sound Quality as well.

The potential for interaction of the project on climate, particularly microclimate effects, are primarily related to changes in wind patterns, snow deposition and the potential for cold air pooling. Wind patterns may be influenced from pressure and temperature differences on a regional scale due to



differences in heating and cooling of land surfaces which can be characterized as either waterbodies, urban areas or rural areas. It is unlikely that Project-related emissions will cause any measurable difference or changes in air or land temperature.

Wind patterns at a more local level may be influenced by changes in topography such as large hills, mountains, or valleys. The presence of the topographical feature may substantially influence the wind flow at the earth's surface, especially with respect to wind direction and wind speed.

The construction of substantive rock cuts could alter the local microclimate by creating a wind tunnel effect, thereby increasing wind speeds within that area. However, the rock cuts and other changes in topography due to construction and operation of the proposed new highway are not expected to cause substantive changes in wind flow (direction or speed) and therefore are not expected to result in substantive changes in microclimate or climate patterns.

Deposition patterns of snow and associated accumulation of snow are likely to be redistributed due to topographical changes as a result of the construction and operation of the proposed new highway. The changes in the distribution of snow deposition and accumulation however, would be isolated to small areas along the proposed new highway and are not expected to be substantive.

Cold air pooling is a weather phenomenon where a cold air mass, being heavier than the surrounding air, flows along the ground in a down gradient direction and experiences a resistance to flow and forms a shallow pool. The resistance may be in the form of a simple barrier created by a change in elevation or other obstruction or a thick growth of vegetation that tends to slow down the flow of the cold air mass (Almkvist 1999; Environment Canada 1984).

In the case of roadways, if the roadway is located in a down gradient area (such as on the side of a hill) and if the elevation of the roadway is higher than the surrounding terrain, there is a potential for cold air pooling to occur. If the pooling occurs for long periods of time over large areas, there may be an adverse effect on the roadway due to cold air flow spillage across the roadway or there may be an adverse effect on the local vegetation because of the colder temperatures.

The topography, land use and cut and fill charts of the planned RoW were examined to assess the potential for cold air pooling. The locations of the planned cuts are in areas where there are large differences in the terrain elevations such that the roadbed would present a relatively small barrier to drainage flows of cold air. Thus in these instances, the existing drainage flows would not be significantly affected. There are three areas along the RoW where the terrain and fill locations coincide to cause a potential for cold air pooling. The land use at these locations is expected to be potato farming with rotation crops such as grain, oil seed and hay. Since these are considered frost resistant, no significant crop damage is expected to occur from cold air pooling.



As noted above, it is not anticipated that the construction and operation of the proposed highway will result in any substantive interaction with microclimate or climate including the primary or secondary climate parameters (temperature, wind characteristics, precipitation and sea states). Climate change environmental effects are therefore not considered further in the assessment.

5.1.5.1.1 Construction

Ambient Air Quality

Potential interactions between the construction activities and Ambient Air Quality are likely to occur in every phase of construction. During the construction phase, heavy equipment (including earth movers, excavation equipment and grading equipment) will be operated. There is potential for environmental effects from dust generated during the earth moving activities as well as emissions of combustion gases, including greenhouse gases (particularly carbon dioxide) from the construction equipment. In addition, there is potential for environmental effects due to emissions from the asphalt plants to be located and operated within the vicinity of the RoW.

Dust generation from construction activities, particularly during site preparation and sub-grade development will occur. Grubbing operations generally create few dust problems since the exposed soil is usually moist and the grubbed areas are seldom left exposed for extended periods. The removal of existing structures and roadways may create some particulate emissions. Blasting, handling of fill, dumping, grading and compaction are potential sources of airborne particulates, which may affect any residences within sight of the activity. Until the roadbed is paved, the movement of construction vehicles over unpaved roadways may generate airborne dust (suspended particulate matter), especially where these vehicles cross from the exposed area to a paved roadway. Dirt or mud clinging to the vehicles will be dispersed into the air as the vehicle accelerates or will fall onto the public roadway to be stirred up by other vehicles. In general, the dust is expected to disperse up to a distance of 300 m from the source.

Sound Quality

Interactions between the construction activities and the Sound Quality are likely for many construction activities. Changes in noise level can be expected due to activities such as blasting and the operation of the heavy equipment. Depending on the number and location of noise sensitive receptors (*i.e.*, residential properties, schools, and hospitals), and other factors affecting noise transmission (*i.e.*, vegetation, topography, meteorological conditions), the environmental effects of noise will vary.

Noise due to construction and noise due to operation of a highway are different in nature and the potential environmental effects may be different as well.



5.1.5.1.2 Operation

Ambient Air Quality

Interactions between the operation of the proposed TCH and Ambient Air Quality are expected to occur. Interactions of the emissions of combustion gases from the vehicle traffic and the Ambient Air Quality VEC are expected to occur primarily within the immediate vicinity of the Project.

Sound Quality

Interactions between the operation of the proposed TCH and Sound Quality are expected to occur. During operation (after construction is completed), the main source of noise will be the highway traffic which is transferred to the proposed TCH.

5.1.5.1.3 Maintenance

Ambient Air Quality

Interactions between the maintenance activities and Ambient Air Quality are expected to occur. During maintenance, mowing and vegetation control equipment, heavy equipment (possibly including paint striping equipment, earth movers, excavation equipment and grading equipment) will be operated. There is potential for environmental effects from dust generated due to some of the maintenance activities as well as emissions of combustion gases, including greenhouse gases (particularly carbon dioxide), from the equipment.

Sound Quality

Interactions between the maintenance of the proposed TCH and Sound Quality are expected to occur. During maintenance, the main sources of noise will be due to the operation of equipment used during maintenance activities, similar to those used during construction but also includes mowing and clearing equipment.

5.1.5.1.4 Accidents, Malfunctions and Unplanned Events

Ambient Air Quality

Potential interactions between the accidents, malfunctions and unplanned events, and the Ambient Air Quality VEC are expected to occur. The environmental effects on air quality related to these events



would be limited primarily to environmental effects on air quality due to fires. There is potential for environmental effects on the environment from fine particles (smoke) due to fires.

Sound Quality

The Project may have some short term, isolated environmental effects on sound quality due to accidents, malfunctions and unplanned events.

5.1.5.2 Environmental Effects Analysis and Mitigation

The environmental effects analysis and mitigation for each of the Project phases is discussed in the following sections.

5.1.5.2.1 Construction

The environmental effects assessment matrix for the construction phase is presented in Table 5.1.12. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Air Quality - Dust Generation (A) - Combustion gases and dust emissions (A)	- Application of dust suppressant - Follow equipment maintenance schedules - Preserve natural vegetation where possible - Minimize activities that generate large quantities of fugitive dust during high winds	2	3	3/4	R	2
	Sound Quality Noise emissions (A)	- Noise controls where possible (e.g., mufflers) - Timing restrictions where warranted	2	3	3/4	R	2
	Greenhouse Gases (Air Quality) Deforestation – reduction in carbon sequestration (A)	Reforestation	2	4	5/6	1	2



Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Roadbed Preparation	Air Quality - Dust Generation (A) - Combustion gases and dust emissions (A)	- Application of dust suppressant - Follow equipment maintenance schedules - Preserve natural vegetation where possible - Minimize activities that generate large quantities of fugitive dust during high winds	2	3	3/4	R	2
	Sound Quality Noise emissions (A)	- Noise controls where possible (e.g., mufflers) - Timing restrictions where warranted	2	3	3/4	R	2
Surfacing and Finishing	Air Quality - Dust Generation (A) - Combustion gases and dust emissions (A)	- Application of dust suppressant - Follow equipment maintenance schedules - Avoid activities that generate large quantities of fugitive dust during high wind events	2	3	3/4	R	2
	Sound Quality Noise emissions (A)	- Noise controls where possible (e.g., mufflers) - Timing restrictions where warranted	2	3	3/4	R	2
Watercourse Crossing Structures	Air Quality Combustion gases and dust emissions (A)	- Application of dust suppressant - Follow equipment maintenance schedules - Preserve natural vegetation where possible - Minimize activities that generate large quantities of fugitive dust during high winds	2	1	3/2	R	2
	Sound Quality Noise emissions (A)	- Noise controls where possible (e.g., mufflers) - Timing restrictions where warranted	2	1	3/2	R	2
Ancillary Structures and Facilities Construction	Air Quality - Dust Generation (A) - Combustion gases and dust emissions (A)	- Application of dust suppressant - Follow equipment maintenance schedules - Preserve natural vegetation where possible - Minimize activities that generate large quantities of fugitive dust during high winds	2	3	3/4	R	2
			2	3	3/4	R	2

Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u>							
Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
	Sound Quality Noise emissions (A)	- Noise controls where possible (e.g., mufflers) - Timing restrictions where warranted	2	3	3/3	R	2

Key:			
Magnitude: 1 = Low e.g., within normal variability of baseline conditions 2 = Medium e.g., increase/decrease with regard to baseline but within regulatory limits and objectives 3 = High e.g., singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries	Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months	Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible	Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive

Ambient Air Quality

Ambient Air Quality may be affected during construction due to emissions associated with construction equipment operations (including asphalt plant emissions), changes in the greenhouse gas balance due to deforestation, and vehicle traffic on existing TCH. Each of these components is discussed below.

Highway Construction Activities

The amount and type of equipment used during construction will vary depending on the construction developer. The development of an inventory of construction equipment used in each phase is approximate and therefore existing information and professional judgement are used to assess the potential for environmental effects. Since paving of the highway involves relatively consistent equipment and resources based on the roadway geometry, the vehicle emissions inventory for the paving phase of construction was selected as the base model for modification and subsequent application to the other construction activities such as grading and the sub-base preparation.

Fugitive emissions such as road dust and dust from storage piles are transient in nature and difficult to characterize based on many factors such as the moisture in the soil, the level of activity at a particular location, and meteorological conditions at the time of the construction activities. Fugitive emissions will



be mitigated by the application of dust suppressants such as water or calcium chloride during periods of heavy activity and/or dry periods to ensure that the airborne dust remains below the ambient standard. Limiting the extent of clearing and restricting activities during windy weather will further mitigate dust emissions. These dust suppression measures are reflected in Section 4.14 of the NBDOT EPP for construction (NBDOT 1998a).

For the purposes of this study, the following assumptions were made with regard to the development of the vehicle emissions inventory for the paving phase of construction:

- a single diesel paver, with an approximate flywheel power of 174 hp, is used per highway lane to be paved;
- paving rate is approximately 0.3 km of highway per hour of paving time;
- asphalt is laid down in three lifts over the entire stretch of each highway lane to be paved;
- four diesel asphalt compactors and 15 heavy-duty diesel hauling trucks accompany each paver during paving operations; and
- each truck hauls approximately 15 tonnes of asphalt from a portable asphalt plant, assuming a roundtrip distance of 10 km.

Emission factors and methodologies published by the US EPA for non-road diesel vehicles (US EPA, 2002) were used to estimate the emissions of sulfur dioxide, carbon dioxide, carbon monoxide, nitrogen oxides, and particulate matter (including PM₁₀ and PM_{2.5}) for the paving phase of construction. Since most vehicles used during construction are powered with heavy duty diesel engines with approximately similar engine displacements, it is reasonable to assume that the proportion of heavy-duty vehicles per km of highway construction would remain fairly constant for all phases of construction.

For the purposes of this study and in order to provide a conservative estimate of vehicle emissions generated during construction, the yearly emissions from highway paving are considered to be equivalent to the yearly vehicle emissions from the other construction activities such as grading and subbase preparation as the relative proportion of vehicle types and hence diesel engines are comparative.

The operation of the associated asphalt plant(s) will be such that the applicable best available techniques for reducing emissions will be considered and implemented (CCME 2002). These techniques may include such things as application of dust suppressants and the use of emissions control technologies such as baghouses.

Emissions associated with asphalt plant operations were estimated using published emission factors (US EPA (2000) and assuming an asphalt tonnage requirement of 7,000 tonnes/km of four-lane highway, with a total highway length of 70.7 km.



The yearly and total emissions for each phase of the construction operations are provided in Table 5.1.13 for the parameters of interest.

Table 5.1.13 Construction Emissions Inventory – Construction Activities

Construction Activity	Timeframe	PM (T/year)	PM ₁₀ (T/year)	PM _{2.5} (T/year)	SO ₂ (T/year)	NO _x (T/year)	CO (T/year)	CO ₂ (T/year)
Clearing and Grubbing	2004	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Grading	2005	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Gravel Subbase Application	2006	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Highway Paving	2007	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Asphalt Plant Emissions	2007	11.1	3.34	2.34	2.72	13.6	32.2	8,166
TOTAL	--	15.5	7.26	5.86	4.64	100	75.4	14,158

T = tonne (1,000 kg)

Greenhouse Gas Balance

Forest and agricultural ecosystems have the ability to remove carbon from the atmosphere (as CO₂), and incorporate this carbon into plant biomass. The decay of this biomass leads to increases in the amount of carbon in soils. Preservation of these carbon sinks is now recognized as an important measure in reducing atmospheric levels of CO₂. The Project will result in the disturbance of approximately 1,100 ha of land consisting of approximately 70% forested land, 20% agricultural land, which results in the potential loss of all carbon in the standing biomass on this land area. Construction activities will also lead to the loss of carbon from soils as a result of the disturbance of soils on the RoW. Loss of soil carbon occurs whenever soils are disturbed, and manipulated, and results from increased activity of soil micro-organisms. The 735 ha of forested lands removed from future production represents 1.2 % of the Carleton-Victoria Forest Products Marketing Board's annual volume from private lands (See Section 5.8.5.2.1).

For the purposes of assessing this environmental effect in the context of the other contaminants of interest, only the net increase in terms of carbon dioxide is considered. Therefore the net reduction in carbon sequestration (carbon dioxide absorption) due to deforestation and hence net increase in carbon dioxide in the atmosphere is considered. Calculations for the carbon sequestration component due to the harvesting activities was conducted using the factor of 3.67 tons (2,000 lbs) of CO₂ per year per acre of forest (ICF 1999).

Existing Vehicle Traffic

Emissions associated with vehicle traffic on the existing TCH were estimated using the average annual daily traffic volumes for vehicles and trucks as provided by NBDOT. The traffic data was used in



conjunction with published US EPA emission factors from Mobile 5 (US EPA 2000) to determine the total emissions to the atmosphere per year for each contaminant of concern. The estimated emissions are presented in Table 5.1.13 of the summary.

Summary

A general inventory summarizing the emissions associated with the construction phase of the project for the contaminants of concern is presented in Table 5.1.14.

Table 5.1.14 Emissions Inventory Summary – Construction Phase

Source	SO ₂ (T/year)	CO ₂ ^A (T/year)	CO (T/year)	NO _x (T/year)	PM (T/year)	PM ₁₀ (T/year)	PM _{2.5} (T/year)
Existing Vehicle Traffic	120.5	41,934	3,454	297.2	40.17	36.2	32.5
Existing Truck Traffic	124.1	58,325	186	627.9	24.82	22.3	20.1
Construction Operations	0.48	1,498	10.8	21.6	1.09	0.98	0.88
Asphalt Plant Emissions ^B	2.7	8,170	32.2	13.6	11.1	3.34	2.34
Deforestation	NA	6,330	NA	NA	NA	NA	NA
TOTAL	247.8	116,257	3,683	960.3	77.18	62.82	55.82

^A Greenhouse gas of interest

^B Asphalt plant emissions will only occur for one year of the construction phase

The number and distribution of equipment used during typical construction practices are expected to have sufficient dispersion of these emissions to prevent a significant effect on local air quality. In addition, the use of properly maintained vehicles and equipment will ensure that vehicle emissions do not adversely affect ambient air quality.

Fugitive emissions such as road dust and dust from storage piles will be mitigated by the application of dust suppressants such as water or calcium chloride during periods of heavy activity and/or dry periods to ensure that the airborne dust remains below the ambient standard. Limiting the extent of clearing and restricting activities during windy weather will further mitigate dust emissions. These dust suppression measures are reflected in Section 4.14 of the NBDOT EPP (NBDOT 1998a).

The 735 ha of forested lands removed from the future production represents 1.2 % of the Carleton-Victoria Forest Products Marketing Board annual volume from private lands (See Section 5.8.5.2.1). Therefore, loss of carbon from standing forest biomass is considered to not be substantive in consideration of the extent of forest harvesting and re-forestation which now occurs in the region. During clearing operations, salvageable wood resources will be allocated for other processing, such as for use as fibre or lumber, with some of this carbon therefore being preserved in a non-atmospheric form. Minimizing the area of soil and vegetation disturbance during construction will help to mitigate losses of carbon from standing biomass and from soils. Although there will be a net loss of sequestered



carbon due to vegetative loss, these are offset by emissions reductions during operation (Section 5.1.5.2.2).

Following construction activities, all areas with the exception of the road surfaces and shoulders, will be revegetated. Soil carbon will therefore be replenished over time once roadside vegetation becomes established and is maintained. The net loss of sequestered carbon due to vegetative loss is offset by emissions reductions during operation (Section 5.1.5.2.2) resulting in an overall decrease in CO₂ emissions.

The number and distribution of the equipment during typical construction practices will allow for sufficient dispersion of these emissions to prevent significant environmental effects on local air quality during most atmospheric conditions. The magnitude, frequency and duration of the construction activities are such that applicable air quality standards are unlikely to be exceeded within the EA boundaries. Therefore, the potential environmental effects of construction activities are considered not significant.

Sound Quality

Noise generated by construction activities is usually louder than normal highway operation, but is of relatively short duration and is also very localized and transient as the roadbuilding work proceeds along the RoW. Noise generated by construction can affect land use directly adjacent to the RoW in the vicinity of the construction activities. Construction will involve typical road building activities such as clearing and grubbing, roadbed preparation and grading, and paving operations. The noise outputs of construction machinery commonly used for these activities at a distance of 4.5 m from the equipment are presented in Table 5.1.15. The level of activity on construction sites will vary with the various phases of construction.

Table 5.1.15 Typical Construction Equipment Noise (Source: May 1978; Cowan 1994)

Equipment Powered By Internal Combustion Engines	Noise Level dB _A at 4.5 m (15 ft)
Earth Moving	
Compactors (Rollers)	75-87
Front Loaders	72-93
Backhoes	72-99
Tractors	76-96
Scrapers, Graders	80-94
Pavers	86-88
Trucks	82-94
Materials Handling	
Asphalt Paver	80-86
Concrete Mixers	77-85
Concrete Pumps	82-84
Cranes (Moveable)	75-86



Table 5.1.15 Typical Construction Equipment Noise (Source: May 1978; Cowan 1994)

Equipment Powered By Internal Combustion Engines	Noise Level dBA at 4.5 m (15 ft)
Cranes (Derrick)	86-88
Stationary	
Pumps	68-72
Generators	72-82
Compressors	75-91
Impact Equipment	
Jack Hammers and Rock Drills	82-98
Impact Pile Drivers (Peaks)	95-105

Roadbed preparation and grading is the activity of longest duration and therefore will have the most potential for affecting nearby residents on a more sustained basis. Construction noise, for the purpose of this assessment, is assumed to be generated by three machines (grader, loader and dump truck), working in a group. Based on the median output levels described in the above table, this would give a combined sustained source level of about 92 dBA at a distance of 15 m and would attenuate 6 dBA for each doubling of distance as the source is localized (May 1978). As a result, any receptor within 400 m of the activity with no other mitigation present for noise would exceed 65 dBA for a short duration, for daytime noise levels. Land clearing and roadbed paving are construction operations which are generally quieter and of shorter duration than roadbed preparation.

Mitigation of the noise during construction for the most directly affected areas (<100 m from construction site) will be accomplished by keeping the equipment in good working order with mufflers and restricting these activities to the daytime hours where warranted. This may not bring levels to within Guidelines at all times, however, actual levels are expected to be lower than the maximum predicted most of the time as the machines will be constantly moving around and will not always be at the nearest point to any particular residence. The work progression clause (Item 946.21 NBDOT (2003) Standard Specifications) states that grade work must be completed within 30 days in a given work area. That work area would then be left alone for an extended period (up to 1 year) until the developer returned to pave the area. In addition to this NBDOT will commit the developer to working from 7:00 am to 7:00 pm only and not before noon on Sundays in areas near NSAs. Asphalt and rock crusher plants will be located away from NSAs. Therefore, the noise levels are not expected to frequently exceed 24-hour L_{eq} of 65 dBA during construction activities. However, higher sound pressure levels generated by these activities are of a short duration and are temporary.

The use of physical barriers to block noise is the most common method to control noise where scheduling or otherwise reducing noise at the source is not possible. This is not practical or warranted in this case based on the expected short duration of construction, the physical location of these areas in relation to the corridors, and the expense of constructing barriers on a temporary basis.

Occasional noise sources such as the dumping of rock may be louder than the working machinery (>125 dB_A at the source). However these high sound levels attenuate quickly due to their short duration (e.g., tailgate slamming during dumping).

Since construction activities will be of relatively short duration and timing restricted where warranted (especially in close proximity to NSAs), construction noise is not expected to cause significant adverse environmental effects. Therefore, the potential environmental effects due to construction activities are considered not significant.

5.1.5.2.2 Operation

The environmental effects assessment matrix for the operation of the proposed TCH is presented in Table 5.1.16. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.16 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u>							
Phase <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Air Quality • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (e.g., mufflers)	1	3	2/2	R	2
Proposed TCH Presence	Air Quality • Combustion gases and dust emissions (A)	• No mitigation proposed	1	3	5/6	R	2
	Sound Quality • Noise emissions (A)	• No mitigation proposed	1	3	5/6	R	2
Key:							
Magnitude:		Geographic Extent:		Frequency:		Ecological/Socio-cultural and Economic Context:	
1 = Low: e.g., within normal variability of baseline conditions		1 = <1 km ²		1 = <11 events/year		1 = Relatively pristine area or area not adversely affected by human activity.	
2 = Medium: e.g., increase/decrease with regard to baseline but within regulatory limits and objectives		2 = 1-10 km ²		2 = 11 - 50 events/year		2 = Evidence of adverse environmental effects.	
3 = High: e.g., singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries		3 = 11-100 km ²		3 = 51 - 100 events/year		N/A = Not Applicable	
		4 = 101 - 1,000 km ²		4 = 101 - 200 events/year		(A) = adverse	
		5 = 1,001 - 10,000 km ²		5 = >200 events/year		(P) = positive	
		6 = >10,000 km ²		6 = continuous			
		Duration:		Reversibility:			
		1 = <1 month		R = Reversible			
		2 = 1 - 12 months		I = Irreversible			
		3 = 13 - 36 months					
		4 = 37 - 72 months					
		5 = >72 months					



Ambient Air Quality

A general inventory of the emissions and greenhouse gas balance associated with the operation phase of the project for the contaminants of concern is presented in Table 5.1.17. Emissions associated with vehicle traffic include the total contribution from the proposed TCH and the existing TCH, were estimated using US EPA published emission factors from Mobile 5 as discussed in Section 5.1.5.2.1 for the construction phase. Calculations for the carbon sequestration due to the harvesting activities was conducted using the factor of 3.67 tons (2000 lbs) of CO₂ per year per acre of forest (ICF 1999).

Table 5.1.17 Vehicle Emissions Inventory/Greenhouse Gas Balance – Operation Phase

Source	SO ₂ (T/year)	CO ₂ (T/year)	CO (T/year)	NO _x (T/year)	PM (T/year)	PM ₁₀	PM _{2.5}
Vehicle Traffic	114	39,511	3,255	280	37.8	34.0	30.6
Truck Traffic	115	54,112	173	583	23.0	20.7	18.6
Deforestation	NA	6,330	NA	NA	NA	NA	NA
TOTAL	229	99,953	3,428	863	60.8	54.7	49.2

T = tonnes

The proposed alignment has been planned as an express corridor, with free flowing traffic. This flow of traffic will result in less fluctuations in travel speed and therefore vehicle operation will be maintained at a more combustion-efficient operating speed. There will therefore be a reduced potential of local environmental effects from traffic. Improved traffic flow, on a regional scale, and more consistent and optimum operating speeds of the vehicles will reduce the overall emissions to the atmosphere. In addition, the designed length of the proposed TCH is shorter than the existing TCH, resulting in a reduced travel distance and hence a net reduction in overall emissions to the atmosphere associated with vehicle traffic. No mitigation is necessary for air emissions from highway traffic. A summary of the net change in emissions is presented in Table 5.1.18.

Table 5.1.18 Summary of Vehicle Emissions Inventory/Greenhouse Gas Balance

Source	SO ₂ (T/year)	CO ₂ (T/year)	CO (T/year)	NO _x (T/year)	PM (T/year)	PM ₁₀	PM _{2.5}
Existing Traffic	245	100,259	3,641	925	65.0	58.5	52.6
Future Traffic*	229	93,623	3,429	863	60.8	54.7	49.2
Project Related Deforestation	NA	6,330	NA	NA	NA	NA	NA
Net Change (%)	-6.5	-0.3	-5.9	-6.8	-6.3	-6.3	-6.3

T = tonnes

* = based on total highway length, does not account for more efficient speed, better grades, or freer flow of traffic.

Loss of carbon from standing forest biomass is considered to be minimal in consideration of the extent of forest harvesting and re-forestation which now occurs in the region. In addition, the reduction in CO₂ due to the reduced highway length and higher operating efficiency of the vehicles results in a net reduction overall of CO₂ associated with the project. All areas with the exception of the road surfaces



and shoulders, will be re-vegetated. Soil carbon that is lost during construction will therefore be replenished over time once roadside vegetation becomes established and is maintained.

The increased speed limit on the new highway from 90 km/hour to 110 km/hour will add to the emissions loading in the region. However, improvements in fuel combustion technologies and alternate means such as hybrid vehicles will result in substantially better fuel economy in future. Smoother flow in traffic will also improve fuel economy. The incorporation of all of these factors into an estimate of emissions is difficult because the specific improvements are not easily characterized at this time. However, over the long term it is likely that the factor with the biggest influence on emissions will be a traffic volume increase of 3.73 per cent per year. This estimated increase in traffic volume and associated emissions is projected to occur irrespective of the Project and will result from external, non-Project related, socio-economic factors, and is therefore not considered to be a Project-induced environmental effect. -

Overall, the improved traffic flow, the lower number of steep gradients on the new highway, the smoother alignment, the shorter highway length, and the larger RoW will help to minimize the potential for adverse effects on the environment.

Sound Quality

In order to predict the noise levels during highway operation, traffic data were obtained from ADI and NBDOT for the existing TCH. Using the average annual daily traffic volumes for vehicles and trucks, hourly traffic flows on the proposed TCH were assumed to be one 24th of the AADT. It was assumed that all truck traffic (100%) and all non-local traffic (assumed to be 80%) will be redirected to the proposed TCH.

The noise prediction model was developed using vegetation and topographical maps of the Project, and the hourly traffic volumes and composition (in terms of the fraction of heavy trucks). The data were input into the traffic noise prediction model (Federal Highway Administration Traffic Noise Model – FHWA-TNM, Version 2.0) to predict the noise levels at the eleven locations, which represent the NSAs. The predicted noise levels from the model are considered to be representative of the 24-hour L_{eq} at the respective NSAs.

The noise modelling conducted for the environmental effects analysis was undertaken for each location to predict the 24-hour L_{eq} noise level at the NSA along the RoW likely to be most affected by the Project. Model assumptions included a tree height of 8.0 m, a road width of 3.66 m and on expectation that all heavy trucks and 80% of other traffic from the existing TCH will move to the Project. The hourly numbers of automobiles, motorcycles, buses and heavy trucks provided by ADI and NBDOT



were used in the model to predict 24-hour L_{eq} (dB_A) at the nearest NSAs during operation of the proposed TCH.

The model predictions for both existing and future operations are presented in Table 5.1.19.

Table 5.1.19 Summary of Noise Assessment – Noise Model Predictions

NSA	Location	Distance to Existing Route 2 (m)	Distance to Proposed TCH (m)	Predicted 24 hr L_{EQ} (dB_A)		Comments
				Existing	Future With Project Operation	
1	Beaconsfield Road	950	200	40.3	46.7	Increase in noise due to the TCH traffic being closer to the NSA.
2	Bowmaster Flats	80	100	46.2	50.1	Increase in noise due to increased TCH traffic in area.
3	Route 560 Site B	1,360	140	44.8	49.2	Increase in noise due to the TCH traffic being closer to the NSA.
4	B Smith Road	1,900	130	47.5	52.6	Increase in noise due to the TCH traffic being closer to the NSA.
5	Backland Road	>2,000	70	47.3	52.5	Increase in noise due to the TCH traffic being closer to the NSA.
6	Sipprell Road	>2,000	300	34.7	40.6	Increase in noise due to the TCH traffic being closer to the NSA.
7	Route 110	>2,000	150	52.2	54.8	No discernable change in noise levels. Distances from the existing Route 2 and the proposed TCH to the NSA are similar.
8	Raymond Road	>2,000	370	51.7	53.3	No discernable change in noise levels. Distances from the existing Route 2 and the proposed TCH to the NSA are similar.
9	Estey Road	1,000	120	45.3	55.6	Increase in noise due to the TCH traffic being closer to the NSA.
10	Palmer Road	840	200	50.6	51.5	No discernable change in noise levels.
11	Route 560 Site A	270	80	54.2	55.6	No discernable change in noise levels. Currently a high volume of traffic in the area.

The traffic noise will be audible in the area, however the predicted levels are below the NBDOT guideline value of 65 dB_A at potential NSAs and are expected to be lower at further distances from the highway. In addition, there will be a positive environmental effect for areas along the existing TCH due to a predicted reduction in noise resulting from reduced traffic flow. Therefore, the potential environmental effects of Operation are considered not significant.



Projected future traffic volumes are anticipated to increase annually by 3.73% (based on a counter near Perth-Andover). A doubling of traffic volume results in approximately a 3 dBA increase in noise level. This would occur approximately every 20 years, assuming a static growth rate and current technologies. However, noise reduction technology is likely to improve in the future. Therefore, the effects of increasing future traffic volumes on predicted future sound quality is predicted to be not significant.

5.1.5.2.3 Maintenance

The environmental effects assessment matrix for the maintenance phase is presented in Table 5.1.20. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.20 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u> Phase <u>Maintenance</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Maintenance	Air Quality • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (e.g., mufflers)	1	3	2/2	R	2
Vegetation and Wildlife Management	Air Quality • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (e.g., mufflers)	1	3	2/2	R	2
Key: Magnitude: 1 = Low: e.g., within normal variability of baseline conditions 2 = Medium: e.g., increase/decrease with regard to baseline but within regulatory limits and objectives 3 = High: e.g., singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible							

Ambient Air Quality

The magnitude, frequency and duration of the maintenance activities are such that applicable air quality standards are unlikely to be exceeded within the EA boundaries. Application of dust suppressants as per



Section 6.1.3 of the EPP such as water during periods of heavy activity and/or dry periods will ensure that the contribution to levels of airborne dust will remain within the ambient standards. The use of properly maintained vehicles and equipment will ensure that vehicle emissions do not adversely affect ambient air quality.

The number and distribution of the equipment during typical maintenance activities (mowing, vegetation clearing) will allow for sufficient dispersion of these emissions to prevent significant environmental effects on local air quality during most atmospheric conditions. Therefore, the potential environmental effects of Maintenance are considered not significant.

Sound Quality

Noise sources that are infrequent and of a short duration, such as the dumping of rock may be significantly louder than the working machinery ($>125 \text{ dB}_A$ at the source). However these high sound levels attenuate quickly due to their short duration.

Since the maintenance will typically be restricted to daylight hours and will be of relatively short duration, noise due to maintenance activities is not expected to cause any substantial adverse environmental effects. Therefore, the potential environmental effects of Maintenance are considered not significant.

5.1.5.2.4 Accidents, Malfunctions and Unplanned Events

The environmental effects assessment matrix for the accidents, malfunctions and unplanned events phase is presented in Table 5.1.21. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.21 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u> Phase <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Fires	Air Quality Combustion gases and dust emissions (A)	Control and mitigate fires	1	3	1/1	R	2
	Sound Quality Noise emissions (A)	Noise controls where possible (e.g., mufflers)	2	2	1/1	R	2

Table 5.1.21 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u> Phase <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Key: Magnitude: 1 = Low: e.g., within normal variability of baseline conditions 2 = Medium: e.g., increase/decrease with regard to baseline but within regulatory limits and objectives 3 = High: e.g., singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible							

Ambient Air Quality

Potential interactions between the Accidents, Malfunctions and Unplanned Events, and Air Quality would be limited to effects caused by emissions of fine particles (smoke) from fires. Improved traffic flow and the divided highway design are expected to result in a reduction of accidents associated with the highway. As such, there would be a reduction in potential for fires associated with accidental events. Since the likelihood of these events to occur is low and since they would be of short duration and magnitude, the potential environmental effects due to Accidents, Malfunctions and Unplanned events are considered not significant.

Sound Quality

Potential interactions between the Accidents, Malfunctions and Unplanned Events, and Sound Quality would be of a short duration and would be infrequent. Since the likelihood of these events to occur is low and since they would be of short duration and magnitude, the potential environmental effects due to Accidents, Malfunctions and Unplanned events are considered not significant.



5.1.5.3 Determination of Significance

The overall results of the EA for the atmospheric environment are presented in a summary matrix (Table 5.1.22). The table also considers the level of confidence of the study team in this determination and the likelihood of potential environmental effects.

Table 5.1.22 Residual Environmental Effects Summary Matrix for Atmospheric Environment

Residual Environmental Effects Summary Matrix				
Valued Environmental Component: <u>ATMOSPHERIC ENVIRONMENT</u>				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	3	2
Maintenance	NS	3	3	3
Accidents, Malfunctions and Unplanned Events	NS	2	1	2
Project Overall	NS	3	3	3
Key				
Residual Environmental Effect Rating:		Probability of Occurrence: based on professional judgement		
S = Significant Adverse Environmental Effect		1 = Low Probability of Occurrence		
NS = Not-significant Adverse Environmental Effect		2 = Medium Probability of Occurrence		
P = Positive Environmental Effect		3 = High Probability of Occurrence		
Level of Confidence		Scientific Certainty: based on scientific information and statistical analysis or professional judgement		
1 = Low Level of Confidence		1 = Low Level of Confidence		
2 = Medium Level of Confidence		2 = Medium Level of Confidence		
3 = High Level of Confidence		3 = High Level of Confidence		
		N/A = Not Applicable		
*As determined in consideration of established residual environmental effects rating criteria.				

The residual environmental effects are considered not significant for all Project activities assessed.

Based on a consideration of the magnitude, frequency and duration of air emissions associated with the Project, the environmental effects of Project activities and potential accident scenarios, independently or together are either considered not significant for all aspects of the Atmospheric Environment VEC. This conclusion is made in consideration of the baseline for air quality and sound quality.

5.1.6 Monitoring and Follow-up

Measurable environmental effects to air quality from dust and noise will likely be localized to the specific construction activities during construction and relatively localized during operation. In addition, there are currently several ambient monitors operated by NAPS / NBDELG in areas surrounding the proposed RoW. Provided the recommended mitigative actions are taken, additional monitoring of ambient air quality and noise is not warranted.



However, noise monitoring may be required to address any complaints from residents living near the highway. Where warranted, noise monitoring will be conducted at specific NSAs, in accordance with methodologies acceptable to NBDELG.





5.2 Groundwater

5.2.1 Rationale for Selection as Valued Environmental Component

Groundwater was selected as a VEC because of its potential importance to the water supply of residents, and because of its relationship with surface water conditions. Some residents have noted the potential for the proposed Project to affect groundwater extraction or transmission from areas that would be intercepted by the proposed alignment. The potential for the disruption or contamination of the groundwater drinking supply for nearby residents therefore requires assessment. Water contaminants include a wide variety of inorganic and organic substances including road salt, as well as physical properties such as silt load and water temperature.

The potential environmental effects of the Project activities on Groundwater resulting from construction and operation, as well as malfunctions, accidents or unplanned events, specifically the accidental spillage of oil or fuel from vehicles, or hazardous cargos from trucks are assessed.

5.2.2 Environmental Assessment Boundaries

5.2.2.1 Spatial and Temporal

The spatial boundaries for the Project include the proposed RoW and the area of influence beyond the boundaries of the proposed RoW. The area of influence or capture area of a typical low yield domestic water well for highway-related potential environmental effects is usually less than about 100 m, and generally where the well is hydraulically downgradient of the proposed RoW. Project related contamination (*i.e.*, road salt) within this capture area could potentially affect well water quality. Vibration damage to a drilled or dug well is generally a function of distance between the energy source and well, and seismic properties of the aquifer materials. With respect to rock type, risk is greater for fractured crystalline bedrock than for overburden wells or sandstone wells. Risk from blasting or major excavation is greatest within 50 m, moderate from 50 to 200 m, and expected to be minimal beyond about 200 m. The assessment boundaries with regard to potential groundwater interactions depend on the type of work being done. Blasting effects are considered for drilled wells within 500 m on both sides of the proposed RoW in those areas found to require blasting for excavation. Potential environmental effects of accidental spills are considered within 500 m hydraulically down-gradient of the proposed RoW assuming highly permeable media (*i.e.*, sand and gravel aquifers), or mineralized bedrock. Road salting environmental effects are considered for all wells located hydraulically downgradient of the proposed alignment.

With respect to temporal boundaries, most physical and chemical environmental effects on groundwater resources are likely to be temporary and to occur during the construction phase. Residual environmental



effects from road de-icing materials could occur throughout the operation phase of the Project. Potential accidents due to spills could occur in both phases of the Project. The temporal boundaries of the Project include the construction period as well as operation of the Project in perpetuity.

5.2.2.2 Administrative and Technical

Water quality is protected through federal and provincial legislation and guidelines. Baseline information for this assessment included available well driller's reports and water chemistry results for wells in the area, as provided by NBDELG from their water well database. A technical boundary for this assessment is that a well water inventory was not undertaken for this study. A residential well water survey will, however, be conducted of wells within 500 m of a blasting area prior to implementing blasting operations in specific areas at risk, or major excavations requiring de-watering, so that appropriate mitigation or compensation can be implemented in the event of an unforeseen environmental effect.

5.2.3 Residual Environmental Effects Rating Criteria

A *significant residual environmental effect* is defined as a Project-related environmental effect that degrades the quality of groundwater resources by exceeding the maximum acceptable concentrations of one or more parameters as specified in the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) for potable domestic water supplies (Health Canada 2003) for a period of more than 30 days. In the event that concentrations of a parameter currently exceed the GCDWQ, any Project-related increase in the parameter concentration is considered significant. A Project effect that reduces the quantity of groundwater recoverable from the aquifer on a sustainable basis to meet present and future needs of current users is also considered significant.

5.2.4 Existing Conditions

This section describes the existing conditions associated with groundwater in the area, including geology, hydrogeology, and groundwater use. These conditions reflect the combined environmental effects of all existing projects and land uses.

5.2.4.1 Physiography and Drainage

Perth-Andover to Woodstock falls into the Chaleur Uplands physiographic division. The Chaleur Uplands comprises a slightly undulating peneplain, varying in elevation between 244 and 305 m. Swampy plains and occasional lakes characterize the uplands, interspersed with eroded valleys and by intervening ridges and peaks, some of which attain elevations in excess of 600 m.



The primary drainage feature within the zone of influence of the Project is the Saint John River and its tributaries. Surface runoff will directly or indirectly discharge to the Saint John River. Groundwater flow is anticipated to follow regional surface topography, towards the Saint John River and/or one of its tributaries.

5.2.4.2 Surficial Geology

Surficial geology of Perth-Andover to Woodstock generally consists of blanket (0.5 to 3 m thick) and veneer (discontinuous over rock, less than 0.5 m thick) lodgement and ablation till. This till often reflects the composition of the underlying bedrock, with silty deposits predominating in areas of sandstone or conglomerates.

Gravel deposits are found in most of the major beds and valley floors within the region. Meltwaters from retreating glaciers brought large quantities of sand and gravel into the main Saint John River Valley and its major tributaries. These deposits are considered to be of local importance for their reserve of available groundwater and for granular resources.

Other Quaternary deposits, including ice-contact stratified materials, glaciofluvial outwash, and post-glacial alluvial terraces may also be found within the zone of influence of the Project. However, the extent of these deposits is poorly defined.

5.2.4.3 Bedrock Geology

The local geology is predominantly highly folded calcareous and argillaceous sedimentary rocks and slates, sandstones and conglomerates of Silurian and/or Ordovician age. A small number of faults are positioned as to intersect the proposed alignment. The faults have been identified in the area of the proposed alignment at Perth-Andover, at the area of the existing on/off ramps; just south of where the proposed alignment crosses Price Brook; and at Upper Woodstock, where the proposed alignment crosses Guisguit Brook.

5.2.4.4 Hydrogeology

In general, the outwash channel and terrace deposits located along the Saint John River are the most important aquifers in the region. These deposits are supplying water to the municipal systems in Woodstock and Hartland, and Bath. About 60 percent of the wells developed in these units have yields between 0.8 and 2 L/s, while 10 percent of the wells yield greater than 4 L/s. Maximum recorded yield is in the order of 100 L/s (NBDOE 1980). The water quality from these unconsolidated glacial deposits is considered to be very good. However, with the exception of approximately 300 m of proposed alignment near Woodstock, the RoW does not intercept these units.



Based on hydrogeological mapping (NBDOE 1980), the proposed alignment may also intercept Quaternary granular deposits in the vicinity of Bryson Brook (less than 1 km of the alignment) and in Waterville (approximately 2 km of alignment). These deposits are typically limited in extent, although large yields may be found locally.

The hydrogeologic units underlying the majority of the proposed alignment between Perth-Andover and Woodstock consist of bedrock in which the groundwater reservoir is relatively small. Within these units, groundwater is confined to fractures and cleavage within the rock. The average well yield in these units is 0.9 L/s (NBDOE 1980). Sufficient water is usually found for domestic water systems, but yields from these bedrock aquifers are not large enough to support major municipal or industrial water supplies.

Overall, the water quality from the bedrock within the zone of influence of the Project can be described as good. The water is generally found to be hard to very hard due to the calcium associated with the bedrock. Nitrate concentrations on occasion have been found to be above background levels in private wells within the farming districts due to agricultural practices.

5.2.4.5 Municipal Water Supplies

The municipalities of Perth-Andover, Bath, Hartland, and Woodstock rely on groundwater for part or all of their water supply. However, the proposed alignment between Perth-Andover and Woodstock is not within 500 m of the municipal wells. Currently, although wellfield protection studies have been completed or are in progress, none of these communities have received designation under the *Wellfield Protected Area Designation Order – Clean Environment Act* (NBDELG 2003b). Once designated, highways may not be constructed within Zone A of the wellfield protected area (i.e., within 100 to 250 days groundwater travel time of the well). The proposed alignment does not intersect the proposed Zone A protected areas of any of the wellfields.

Based on information provided by the municipalities, the proposed alignment does not intersect any existing water distribution lines.

5.2.4.6 Private Water Wells

The proposed alignment passes through predominantly rural settings. Residential water supplies outside of the municipalities noted in Section 5.2.4.5 are provided by individual on-site dug or drilled wells. Approximately 340 properties have been identified as potentially having a private well. For identification purposes, all properties with a building within 500 m of the proposed alignment were assumed to have an on-site well. The majority of these properties are located near roads that are crossed by the proposed alignment, as indicated on Figure 3.2.



Currently, approximately 25 properties with wells have been purchased by NBDOT and the on-site wells decommissioned, pursuant to Section 27 *Water Well Regulation* under the *Clean Water Act*. Each of the wells was filled and sealed in a manner sufficient to prevent both the entry of surface water and the intermixing of groundwater from different aquifers. Should additional domestic wells be encountered during construction, they will be decommissioned as per the NBDELG *Guidelines for Decommissioning of Wells*.

The NBDELG provided Well Driller's Reports and water chemistry data from its database for water wells drilled within the zone of influence of the Project. Construction information for six wells was provided by the NBDELG, and is summarized in Table 5.2.1. In general, the wells were drilled to moderate depths, and provided moderate yields. In most of the wells, bedrock was encountered at shallow depths and the casing length met the minimum requirement (*i.e.*, 6 m).

Table 5.2.1 Summary of Water Well Constructions within 500 m of the RoW

PID	Casing Length (m)	Well Depth (m)	Yield (L/s)	Depth to Bedrock (m)
10178648	na	35.1	0.34	2.4
10134914	5.8	59.4	0.53	1.8
10139434	6.1	41.1	0.53	4.3
10043362	12.2	47.2	0.76	10.7
10224731	6.1	44.2	1.14	2.7
10064723	6.1	93.0	0.53	0.3
Minimum	5.8	35.1	0.34	0.3
Maximum	12.2	93.0	1.14	10.7
Mean	7.3	53.3	0.64	3.7

Water chemistry results were available from three wells as summarized in Table 5.2.2. The results are consistent with earlier reports that indicated the groundwater in the area is relatively hard, and suggest that all three samples were obtained from the bedrock aquifers.

In two of the samples, the concentration of nitrate/nitrite was at or near the guideline for Canadian drinking water (Health Canada 2003). Guidelines for nitrate and nitrite are based on potential human health effects.

Table 5.2.2 Well Water Chemistry

	Units	CDWQ ¹	Samples		
Aluminum	mg/L	0.1	0.009	< 0.03	< 0.025
Alkalinity	mg/L	-	204	200	170
Antimony	ug/L	6	2.6	< 1	< 1
Arsenic	ug/L	25	7.3	< 1	< 1
Barium	mg/L	1	0.078	0.067	< 0.01
Boron	ug/L	5000	0.01	0.011	< 0.2



Table 5.2.2 Well Water Chemistry

	Units	CDWQ ¹	Samples		
Cadmium	ug/L	5	-	< 0.1	< 0.5
Calcium	mg/L	-	115.88	112	71.8
Chloride	mg/L	250	78.96	59.6	10.8
Chromium	ug/L	50	-	-	15
Conductivity	µSIE/cm	-	767	732	378
Copper	ug/L	1000	1	2	< 10
Fluoride	mg/L	1.5	0.09	0.024	< 0.1
Hardness (as CaCO ₃)	mg/L	-	333.9	324.5	197.8
Iron	mg/L	0.3	0.031	< 0.001	0.019
Lead	ug/L	10	< 1	1.4	< 1
Magnesium	mg/L	-	10.81	10.9	4.5
Manganese	mg/L	0.05	< 0.01	0.001	< 0.01
NO ₂ (as N)	mg/L	3.2	< 0.05	< 0.05	< 0.05
NO ₃ (as N)	mg/L	10	10	10.85	1.32
NO _x (as N)	mg/L	10	10	10.9	1.37
pH		6.5 - 8.5	7.79	7.8	7.65
Potassium	mg/L	-	2.52	2.52	0.241
Selenium	ug/L	10	-	-	< 1
Sodium	mg/L	-	23.05	19.6	3.3
Sulfate	mg/L	500	40.68	40.5	8.87
Titanium	ug/L	-	0	< 1	< 1
Turbidity	NTU	1	0.1	0	0.4
Zinc	ug/L	5000	11	14	22
Total Coliforms	P/A ²	0	P	A	P
E. coli	P/A	0	A	A	A

Notes:

¹ CDWQ = Canadian Drinking Water Quality Guidelines (Health Canada 2003)

² P/A = Presence/Absence

BOLD = parameter exceeds CDWQ

'-' = value not available

Total coliform were present in two of the three well water samples. Total coliform are considered to be an indicator of the overall water quality. The guideline for total coliform is based on health considerations. In well water, the presence of total coliform in the absence of E. coli is an indicator that the well is prone to surface water infiltration and therefore at risk of contamination from the surface.

The concentration of chloride in two of the three samples was relatively high (*i.e.*, > 50 mg/L) compared to typical concentrations in Canadian drinking water of 10 mg/L (Health Canada 1996). However, all concentrations were less than the guideline for Canadian drinking water (Health Canada 2003). These concentrations may be the result of local geological conditions, or may reflect environmental effects from winter road salt storage and/or application by the property owner or an adjacent landowner. The guideline for chloride concentrations in drinking water is based on aesthetic objectives (*i.e.*, taste, corrosion of pipes).

5.2.4.7 Potentially Contaminating Land Uses

Based on available NBDELG records, three abandoned dumpsites are located within 500 m of the proposed RoW.

One dumpsite (PID No. 65053217) is located in Perth-Andover, approximately 400 m to the east of the proposed alignment. From 1940 to 1950, the site operated as an open municipal dump with burning. Although the site has since been covered with soil, the disposal area of this dumpsite reportedly covered 1.5 hectares. The general soil type at this dumpsite is described as gravel/clay. As the site is located between the proposed alignment and the Saint John River, it is considered to be downgradient of the proposed alignment. NBDELG records indicate that this site is being monitored. Since this site is being monitored and is located 400 m downgradient of the proposed RoW, mitigation during construction of the proposed TCH would not be required.

The second abandoned dumpsite (PID No. 10064343 and 10090546) is located on the A. Brown Road in Summerfield, approximately 100 m from the proposed RoW. This site is owned by NBDOT and operated from the early 1970's until its closure in 1994. The dumpsite is located on a side hill. Reportedly, the disposal area covered 0.37 hectares and was an open trench municipal dump with burning. The general soil type at this dumpsite is gravelly sandy silt with some clay. Surface and groundwater from the properties would be expected to flow to the north, following topography towards the Lower Guisguait Brook, approximately 140 m from the dump site. The NBDELG has completed assessment and long term monitoring of this site, and considers the closure work to be 99 percent complete (M. Barner, pers. comm. 2003). As a result, mitigation during construction of the proposed TCH would not be required.

A third dumpsite (PID No. 10224301) is located in Florenceville, approximately 300 m from the eastern ramp alignment of the Dump Road crossing. From 1957 to 1969, the site was operated as an open municipal dump with burning. The disposal area of this dumpsite reportedly covered 31.5 hectares. A recent assessment (Craig Hydrogeologic 2003) indicates that groundwater and surface water drainage at the site are anticipated to be to the west, towards the proposed alignment. Based on discussions with the NBDELG (A. Spencer, pers. comm., 2003), additional work would typically be required for a site of this type; however, as the site is now privately owned, a timeframe for completing additional site investigations and improvements could not be provided. There has been no groundwater sampling completed at the site, nor was a water sample collected from a domestic well-located 100 m downgradient of the dumpsite. A small watercourse, located between the eastern ramp alignment and the dumpsite, is expected to provide a hydrologic barrier, and hence interaction between the Project and surface drainage from the dumpsite is not anticipated. As the Project alignment in the vicinity of the eastern ramp is located in a large fill, interaction with groundwater originating from the dumpsite is not anticipated.



5.2.5 Environmental Effects Analysis

5.2.5.1 Project-VEC Interactions

This section evaluates the potential for Project-related activities to affect groundwater quality and/or quantity. Table 5.2.3 provides a summary of the potential environmental effects resulting from the Project-VEC interactions.

Table 5.2.3 Project Activity – Environmental Effects Interaction Matrix for Groundwater

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>GROUNDWATER</u>		
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effect	
	Change in Groundwater Quality	Change in Groundwater Quantity
Construction		
Site Preparation	✓	✓
Roadbed Preparation	✓	✓
Surfacing and Finishing	✓	
Watercourse Crossing Structures	✓	✓
Ancillary Structures and Facilities Construction	✓	
Operation		
Winter Safety	✓	
Proposed TCH Presence	✓	✓
Maintenance		
Proposed Maintenance	✓	
Vegetation and Wildlife Management		✓
Accidents, Malfunctions and Unplanned Events		
Hazardous Material Spills	✓	

5.2.5.1.1 Construction

Construction activities that have the potential to affect groundwater quality and/or groundwater quantity include:

- clearing, grubbing and stripping of vegetation during site preparation;
- blasting and major excavations associated with roadbed preparation and site preparation for watercourse crossings and bridge construction; and
- surfacing and temporary ancillary facilities which involve the application and mixing of asphalt.



The clearing, grubbing and stripping of vegetation may lead to increased surface runoff, since there is no vegetation to intercept precipitation or impede the flow of water. Surface runoff from cleared and grubbed areas typically contains sediments. Shallow wells and springs, which are more susceptible to direct surface water influence, could experience an increase in turbidity if exposed to this runoff. As well, increasing the amount of surface runoff reduces the amount of infiltration into the ground, thereby decreasing the amount of groundwater recharge.

Blasting activities are commonly the cause of complaint from well owners. The major complaints of changes in well water quality include increased turbidity, discoloured water, and nitrate and/or coliform contamination due to damage of casing seal. The major complaints for changes in well water production capacity include loss of quantity production, air in water and/or water lines, damage to pump, and damage to well screen or borehole.

Major excavations associated with cut-and-fill operations during roadbed preparations and watercourse crossings have the potential to affect groundwater quantity and/or quality in nearby or down-gradient shallow water wells. Typical complaints are temporary increases in turbidity and decreased yield or "dry" wells due to a lowering in the water table.

Runoff during paving operations and from asphalt plant locations may contain dissolved hydrocarbons. At least part of this runoff will infiltrate the ground, introducing dissolved contaminants into the groundwater flow system. Vibrations from equipment have also been reported to environmentally effect water wells in close proximity, generally resulting in temporary increases in turbidity.

5.2.5.1.2 Operation

Operation of the highway has the potential to affect groundwater quality and/or groundwater quantity by:

- affecting local groundwater quality due to dissolved contaminants in runoff from the highway;
- lowering of the water table due to ditching, cutting, and grading; and
- reducing groundwater recharge due to the increase in impervious surface area and changes in drainage patterns.

Runoff from roads and highways may contain contaminants such as lubricants, coolants, vehicle deposits, and road salt (US EPA 1996). Some runoff may infiltrate into the ground, introducing dissolved contaminants into the groundwater system. As road salt is applied directly to the road surface, its potential to affect the groundwater system is considered to be substantially higher than other potential contaminants whose origins are vehicle-related.



Impervious materials, such as asphalt, prevent the infiltration of precipitation into the ground, thereby reducing the amount of groundwater recharge. Similarly, ditching and cutting modify local drainage patterns, thereby reducing groundwater recharge and potentially resulting in a local lowering of the water table.

5.2.5.1.3 Maintenance

Runoff during paving operations may contain dissolved hydrocarbons. At least part of this runoff will infiltrate into the ground, introducing dissolved contaminants into the groundwater flow system. Vibrations from equipment have also been reported to affect water wells in close proximity, generally resulting in temporary increases in turbidity.

Since NBDOT uses mechanical means to maintain vegetation control, ongoing maintenance of vegetation is not expected to affect groundwater quality. However, the removal of vegetation will reduce the amount of precipitation that is intercepted, thereby increasing runoff. This could result in a local reduction in groundwater recharge and a lowering of the water table.

5.2.5.1.4 Accidents, Malfunctions and Unplanned Events

Malfunctions and accidents that could potentially affect groundwater quality include fuel spills, resulting in hydrocarbon contamination of downgradient aquifers. Also, the accidental releases of blasting chemicals (such as ammonia, nitrates, and fuel oil) directly into the groundwater are considered.

5.2.5.2 Environmental Effects Analysis and Mitigation

The criteria for characterizing the magnitude of environmental effects are described in the key for each phase of the Project. The criteria for characterizing the geographic extent of environmental effects are as follows:

- $< 1 \text{ km}^2$ (includes the area within a 100 m radius of a typical low yield domestic well);
- $1\text{-}10 \text{ km}^2$ (includes the area within a 500 m radius of a single well);
- $10\text{-}50 \text{ km}^2$ (includes the area within 500 m downgradient of the RoW);
- $50\text{-}100 \text{ km}^2$ (includes the area within 500 m either side of the RoW); and
- $> 100 \text{ km}^2$ (includes the area outside of the Assessment Area).

5.2.5.2.1 Construction

During construction of the proposed TCH and associated roads and structures, several activities could result in a change in groundwater quality or quantity. These include grubbing and stripping of



vegetation during site preparation; blasting and major excavations associated with roadbed preparation and site preparation for watercourse crossings and bridge construction; and surfacing and temporary ancillary facilities which involve the application and mixing of asphalt. The sections following Table 5.2.4 evaluate the potential residual environmental effects resulting from the interaction between construction activities and groundwater, and proposed mitigative strategies.

Table 5.2.4 Environmental Effects Assessment Matrix for Groundwater (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>GROUNDWATER</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in groundwater quality (A)	Erosion and sediment control measures will be taken to reduce surface runoff	2	3	1/1	R	2
	Change in groundwater quantity (A)	Erosion and sediment control measures will be taken to reduce surface runoff	1	4	1/1	R	2
Roadbed Preparation	Change in groundwater quality (A)	- Preblast well surveys - Ripping instead of blasting near residential areas - Erosion control (EPP, EFG) - Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	2	3	1/1	R	2
	Change in groundwater quantity (A)	- Preblast well surveys - Ripping instead of blasting near residential areas - Erosion control (EPP, EFG) - Minimize water table lowering - Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	1	4	1/1	R	2
Surfacing and Finishing	Change in groundwater quality (A)	Erosion and sediment control measures will be taken to reduce surface runoff as required	1	3	1/1	R	2



Table 5.2.4 Environmental Effects Assessment Matrix for Groundwater (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>GROUNDWATER</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-cultural and Economic Context
Watercourse Crossing Structures	Change in groundwater quality (A)	• Preblast well surveys • Ripping instead of blasting near residential areas • Minimize water table lowering • Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	2	3	1/1	R	2
	Change in groundwater quantity (A)	• Preblast well surveys • Ripping instead of blasting near residential areas • Minimize water table lowering • Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	1	4	1/1	R	2
Ancillary Structures and Facilities Construction	Change in groundwater quality (A)	• Managed site, as per EPP and EFG, and any other applicable permits or regulations	1	3	1/1	R	2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of groundwater resources in the shallow or deep aquifer, such that these resources are either unavailable or unusable at levels that are indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of groundwater resources, such that these resources are occasionally rendered unusable to current users for periods up to two weeks at a time 3 = High: e.g., limiting the available quantity and quality of groundwater resources, such that these resources are rendered unusable or unavailable for current users during the life of the Project Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 10-50 km² 4 = 50 - 100 km² 5 = > 100 km² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Site Preparation

Clearing and Grubbing

Clearing, grubbing and stripping activities associated with site preparations will decrease interception of precipitation by vegetation and increase runoff in these areas, which would result in a reduction of groundwater recharge (*i.e.*, a decrease in groundwater quantity) and an increase in water turbidity within shallow wells and springs.

Erosion from grubbed and stripped areas is only a concern to shallow dug wells and springs in very close proximity to the proposed RoW (*i.e.*, a few tens of metres) and where direct overland flow of silt occurs. Potable springs have not been identified close to the proposed RoW and, based on the surficial geology mapping, the overburden materials along the majority of the proposed alignment are expected to be relatively shallow (*i.e.*, less than 3 m) reducing the potential for shallow dug wells. Environmental effects to surface watercourses by uncontrolled erosion are a more important concern (refer to Section 5.2.4).

Erosion control systems will be in place to manage runoff from the construction areas, minimizing the amount of runoff that occurs. Several generic measures that can be taken to prevent sedimentation and minimize erosion potential include: fitting the development to the terrain; construction sequencing to minimize soil exposure; retaining existing vegetation as long as possible; vegetation and mulching of denuded areas; diverting runoff away from denuded areas; minimizing length and steepness of slopes; keeping runoff velocities low; properly sizing and protecting drainage ways and outlets; intercepting sediments on site; and inspecting and maintaining control measures. Erosion control measures are identified in the EPP (Section 4) and EFG (Sections 4.2, 4.3) and are expected to include erosion control fencing, check dams, use of mulch (possibly from shrubs and trees removed during clearing) and, if necessary, sedimentation control ponds. As these erosion control measures also slow the transport of surface runoff, they will also increase the potential for localized infiltration to groundwater.

Roadbed Preparation and Watercourse Crossing Structures

Blasting and Excavations

Blasting can cause environmental effects in adjacent wells ranging from minor temporary turbidity to rare complete collapse of the well. The severity of the environmental effect is proportional to distance, physical and seismic properties of the bedrock being excavated, age and construction method of the well, well yield, and blast magnitude. Most of the proposed alignment avoids populated areas; however, a number of properties with the potential for on-site wells have been identified. Ripping techniques will be used where possible in lieu of blasting, in proximity to residential water wells.



Major excavations through tills could lead to a drop in groundwater table elevations in proximity to the cut. The degree of water level lowering will be proportional to the depth of the cut below the natural water table level, the distance between the well and the cut, and the hydraulic properties of the overburden materials (*i.e.*, larger and faster decline in higher permeability media). Dug wells near the edge of a cut could suffer sufficient water level decline to become dry. Drilled wells are not likely to be adversely affected by overburden cuts.

The time required to keep excavations open will be minimized during construction. Any dug wells located within 50 m of a major highway cut or overpass will therefore be inspected, measured for water level and depth, and inventoried for possible future reference. If the quantity or quality of water is affected in the individual wells, remedial action will be implemented (*e.g.*, temporary water supply, provision of new deep well). Based on the hydrogeology within the zone of influence of the Project, it is anticipated that most of the water wells in close proximity to the proposed alignment are completed in bedrock and hence are unlikely to be noticeably affected by large excavations.

Surfacing and Ancillary Structures

Runoff from paving areas may contain dissolved hydrocarbons, and vibration from equipment may cause temporary increases in turbidity in adjacent wells. However, the concentration of dissolved hydrocarbons in any runoff from these areas is expected to be at trace levels. Proper staging of the paving (*e.g.*, dry weather application, drainage controls as required, paving of the roadway in sections) and vibration controls will minimize any potential impacts.

Based on consideration of the potential environmental effects of the individual activities associated with the construction phase of the Project, the proposed mitigation (*e.g.*, EPP and EFG), and the residual environmental effects criteria, the environmental effects on Groundwater by these activities are considered not significant.

5.2.5.2.2 Operation

The following provides an evaluation of key potential Project-VEC interactions for the operation phase of the Project as summarized in the environmental effects assessment matrix (Table 5.2.5). Operation of the Project will continue in perpetuity upon completion of the construction phase of the Project.

The main potential adverse environmental effect on Groundwater during the operation and maintenance phase of the Project is change in groundwater quality due to road-runoff. Although there are a number of potential contaminants in road runoff (*e.g.*, lubricants, coolants, vehicle deposits), road salt is considered to have the greatest potential to affect groundwater quality. During winter, salt is used by NBDOT on road surfaces to aid in melting snow, and to provide clear road conditions. Road salt can



enter into the environment (surface water, groundwater and soil) through storage and application of these salts. The highest concentrations are usually associated with winter and spring thaws. Environment Canada has concluded that "road salts that contain inorganic chloride salts with or without ferrocyanide salts are "toxic" as defined in Section 64 of CEPA" (Environment Canada 2001c).

Table 5.2.5 Environmental Effects Assessment Matrix for Groundwater (Operation)

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>GROUNDWATER</u>							
Phase: <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in groundwater quality (A)	- Proper salt management - Apply drainage controls - Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	1	1-3	1/3	R	2
Proposed TCH Presence	Change in groundwater quality (A)	Minimize extent of clearing	1	3	1/6	R	2
	Change in groundwater quantity (A)	Minimize extent of clearing	1	4	1/6	R	2

Key:

Magnitude:

1 = Low: e.g., affecting the available quantity or quality of groundwater resources in the shallow or deep aquifer, such that these resources are either unavailable or unusable at levels that are indiscernible from natural variation

2 = Medium: e.g., limiting the available quantity or quality of groundwater resources, such that these resources are occasionally rendered unusable to current users for periods up to two weeks at a time

3 = High: e.g., limiting the available quantity and quality of groundwater resources, such that these resources are rendered unusable or unavailable for current users during the life of the Project

Geographic Extent:

1 = <1 km²

2 = 1-10 km²

3 = 10-50 km²

4 = 50 - 100 km²

5 = >100 km²

Duration:

1 = <1 month

2 = 1 - 12 months

3 = 13 - 36 months

4 = 37 - 72 months

5 = >72 months

Frequency:

1 = <11 events/year

2 = 11 - 50 events/year

3 = 51 - 100 events/year

4 = 101 - 200 events/year

5 = >200 events/year

6 = continuous

Reversibility:

R = Reversible

I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse environmental effects.

N/A = Not Applicable

(A) = adverse

(P) = positive

Environment Canada recently completed an assessment of road salt under CEPA. Recognizing that a total ban of road salt could potentially compromise human safety, the focus of road salt risk management is on implementation measures that optimize winter road maintenance practices so as to not jeopardize road safety while minimizing the potential environmental effects (Environment Canada 2001c). Therefore Environment Canada has categorized road salt as a Track 2 substance, requiring Life-Cycle Management. Management instruments to reduce the potential environmental effects of road salts are being developed through a national multi-stakeholder group (which involves representation from NBDOT) working in conjunction with Environment Canada. A proposed *Code of Practice for the Environmental Management of Road Salts* was published in the *Canada Gazette* on September 30, 2003.



The period for comment is now complete, and Environment Canada will publish the file Code in 2004. Under the proposed Code, all organizations that use more than 500 tonnes of road salt per year (e.g., NBDOT), should prepare and implement a salt management plan.

NBDOT is committed to developing best salt management practices in a continued effort to reduce the environmental effects of road salt on the environment. Currently the EPP (Section 6.2) and the EFG (Section 5.6) identify salt storage and application protection measures. Application rates identified in the Highway Maintenance Management System Field Manual (NBDOT 1992b) will be used to maximize the efficiency of salting and sanding. The drainage of salt laden runoff away from residences and their wells along ditching will likely mitigate this potential environmental effect on any nearby residential wells. Road maintenance activities will be managed to minimize the potential effects on adjacent residential wells.

Once the highway has been completed, there will be a permanent decrease in the amount of infiltration to groundwater. However, as the surface extent of the proposed highway within any one watershed is substantially smaller than the total watershed area, the magnitude of this effect will be imperceptible to groundwater users.

Based on consideration of the potential environmental effects of the individual activities (i.e., road salt application) and the physical presence of the proposed TCH and associated roads, the proposed mitigation (e.g., EPP, EFG, Highway Maintenance Management System Field Manual (NBDOT 1992b), drainage controls), and the residual environmental effects significance rating criteria, the environmental effects on Groundwater by these activities are considered not significant.

5.2.5.2.3 Maintenance

Routine highway maintenance may potentially interact with groundwater. An evaluation of these Project-VEC interactions is summarized in Table 5.2.6.

Runoff from paving areas may contain dissolved hydrocarbons, and vibration from equipment may cause temporary increases in turbidity in adjacent wells. However, the concentration of dissolved hydrocarbons in any runoff from these areas is expected to be at trace levels. The potential for environmental effects will be mitigated by the effective implementation of the EPP (Section 6.1) and EFG (Section 4.4). Proper staging of the paving (e.g., dry weather application, drainage controls as required, paving of the roadway in sections) and vibration controls will minimize any potential environmental effects. The likelihood of an environmental effect on Groundwater from runoff and vibration environmental effects during paving activities is considered to be very low.



Table 5.2.6 Environmental Effects Assessment Matrix for Groundwater (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>GROUNDWATER</u> Phase: <u>Maintenance</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Proposed TCH Maintenance	Change in groundwater quality (A)	- Drainage and vibration controls - Remedial action as necessary to restore damaged wells and provide temporary potable water as needed	1	1-3	1/1	R 2
Vegetation and Wildlife Management	Change in groundwater quantity (A)	Minimize extent of clearing	1	3	1/1	R 2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of groundwater resources in the shallow or deep aquifer, such that these resources are either unavailable or unusable at levels that are indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of groundwater resources, such that these resources are occasionally rendered unusable to current users for periods up to two weeks at a time 3 = High: e.g., limiting the available quantity and quality of groundwater resources, such that these resources are rendered unusable or unavailable for current users during the life of the Project Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 10-50 km² 4 = 50 - 100 km² 5 = > 100 km² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive						

Based on consideration of the potential environmental effects of the individual activities associated with the maintenance of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, drainage controls), and the residual environmental effects significance rating criteria, the environmental effects on Groundwater by these activities are considered not significant.

5.2.5.2.4 Accidents, Malfunctions and Unplanned Events

The evaluation of key potential Project-VEC interactions for accidents, malfunctions and unplanned events is summarized in the environmental effects assessment matrix (Table 5.2.7). The main issues related to Groundwater are hazardous material spills.

The release of hazardous materials into the environment may result from the leaks from machinery used during construction, from fuel and chemical transportation accidents, from blasting chemicals, or from leaks from storage facilities. The accidental release of a large quantity of a hazardous liquid onto the



ground could render the local groundwater resource unusable for a long period of time, possibly the life of the Project (in perpetuity). However, the likelihood of construction or maintenance related accidents of high magnitude occurring is very low due to the storage and handling procedures in the EPP (Sections 4.19, 6.5 and 8.1), EFG (Section 5.0), and applicable regulations.

Table 5.2.7 Environmental Effects Assessment Matrix for Groundwater (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>GROUNDWATER</u> Phase: <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Materials Spills	Change in groundwater quality (A)	- Implementation of emergency environmental response plan in the event of a spill - Remedial action as necessary to restore damaged wells and/or provide temporary potable water as needed - In event of a spill during operation, the TDG SOP will be followed.	1-3	1-6	1/1	R/I	2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of groundwater resources in the shallow or deep aquifer, such that these resources are either unavailable or unusable at levels that are indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of groundwater resources, such that these resources are occasionally rendered unusable to current users for periods up to two weeks at a time 3 = High: e.g., limiting the available quantity and quality of groundwater resources, such that these resources are rendered unusable or unavailable for current users during the life of the Project. Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 10-50 km² 4 = 50 - 100 km² 5 = > 100 km² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Accidents during the operational phase of the Project are primarily related to traffic accidents, most importantly the potential spill of a transport vehicle carrying hazardous cargo (e.g., petroleum products). The transport of dangerous goods is strictly regulated by New Brunswick and Canada. Spill response is very well co-ordinated by Provincial and Federal authorities. Emergency response plans are in place and would be implemented in the event of a chemical release to the environment. Under Section 7 of the *Transportation of Dangerous Goods Act*, an emergency response assistance plan (ERAP) is required when the quantity of dangerous goods exceeds a certain limit. The ERAP would be followed in the



event of a spill. Assuming that emergency spill response plans are in place and carried out effectively, it is considered extremely unlikely (almost no chance of occurrence) that a spill event capable of producing a high magnitude environmental effect (Table 5.2.7) would occur during the life of the Project (in perpetuity). Therefore, a significant environmental effect from a large-scale spill is considered possible, but extremely unlikely.

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event involving the release of a hazardous material into the groundwater, the proposed mitigation (e.g., EPP, EFG, ERAP), and the residual environmental effects significance criteria, the environmental effects on Groundwater by these accidents is considered significant. However, the potential for adverse environmental effects of this magnitude to occur is considered to be very low and highly unlikely.

5.2.5.3 Determination of Significance

Table 5.2.8 summarizes the significance potential of residual environmental effects resulting from the interaction between Project activities and groundwater, taking into account any proposed mitigation. Based on consideration of the Project-related and it is concluded that the groundwater resources in the vicinity of the Project have the capacity to meet the needs of the present and those of the future.

Table 5.2.8 Residual Environmental Effects Summary Matrix for Groundwater

Residual Environmental Effects Summary Matrix Valued Environmental Component: GROUNDWATER				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	1	3
Operation	NS	3	1	3
Maintenance	NS	3	1	3
Accidents, Malfunctions and Unplanned Events	S	3	1	3
Project Overall	NS	3	1	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				



5.2.5.4 Monitoring and Follow-up

A number of wells may be located within 500 m of the Project, particularly near locations where the proposed alignment crosses an existing road. The developer(s), on behalf of NBDOT, will complete an inventory of residential water wells within 500 m prior to initiating any blasting. This will include an interview with the well owner, documentation of well construction specifics, collection of a water sample for chemical and bacteria analysis, and photographic documentation of the well location. Where several wells are present within the 500 m blast monitoring radius, selected representative proximity wells will be inspected, sampled, and closely monitored during the construction phase.

If dug wells are located within 50 m of a major (> 5 m) highway cut or overpass, these wells will be inspected (measuring depth, yield and water level in dug wells) by a licensed well inspector, and sampled for baseline water quality.

The developer(s) will implement a contingency plan to provide temporary water during construction, and to repair or replace any wells found to be permanently damaged, in the event that wells are adversely affected by the Project.



5.3 Surface Water

5.3.1 Rationale for Selection as Valued Environmental Component

Surface Water was selected as a VEC because of the potential for interactions between Project activities and the physical aquatic environment, and because of the relationship between surface water conditions and the health of fish and fish habitat. Surface Water is also a VEC because of some recreational contact (primarily angling) on the larger streams that cross the RoW. None of the streams are used as a water supply, thus issues relating to human drinking water quality and quantity are not assessed.

In the context of this VEC, Surface Water is defined as the chemical, physical and biological attributes of surface water including, but not limited to, suspended sediments, flow regime, water quality and water quantity. Surface Water includes any flowing or free-standing water in lakes, reservoirs, ponds, rivers, streams, or other watercourses. The Project is not expected to interact with brackish or saline waters.

Surface Water VEC includes consideration of sulfide bearing rock drainage potential. The concern with sulfide bearing rock is its drainage potential into surface waters due to the fresh exposure of bedrock as a result of the highway construction where the grades require bedrock exposure and excavation. The primary potential environmental effect of sulfide bearing rock drainage is a potential pH reduction of adjacent waterbodies.

In this section, the environmental effects of the Project activities on the Surface Water environment resulting from construction and operation, as well as malfunctions, accidents or unplanned events are assessed.

5.3.2 Environmental Assessment Boundaries

5.3.2.1 Spatial and Temporal

The spatial boundaries (the "Assessment Area") for the assessment of the potential environmental effects of the Project on surface water include all watercourses that will be crossed by the proposed TCH, from the headwaters to the confluence with the Saint John River, and all open-water surface water bodies (*i.e.*, lakes and ponds) within 500 m of construction activities.

The temporal boundaries for the assessment of the potential environmental effects of the Project on surface water include the periods of construction, operation and maintenance of the Project in perpetuity.



5.3.2.2 Administrative and Technical

Surface Water is protected through federal and provincial legislation. Water quality of watercourses is protected in New Brunswick under the *Clean Water Act*. As noted above, activities that could alter water quality of watercourses are regulated under the *Clean Environment Act—Watercourse Alteration Regulation*. Under the *Water Classification Regulation—Clean Water Act*, water quality standards are established for classified lakes and rivers in New Brunswick. As the watercourses within the Assessment Area have not been classified, it is assumed that all of the watercourses may be classified as Class A, which would require that the watercourses be managed to have water quality and aquatic life as it occurs naturally. The quality of water for recreational use is assessed in relation to the *Recreational Water Quality Guidelines and Aesthetics* (CCME 1999). The quality of water from an aquatic perspective are assessed in relation to the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 1999) and in compliance with subsection 36(3) of the *Fisheries Act* regarding the deposit of a deleterious substance.

Information used to assess surface water resources was obtained during field surveys as well as through map and aerial photograph interpretation. Qualitative observations include those that were made when performing field inspections of the Project watercourse crossing locations using NBDNR/DFO stream survey and habitat assessment forms. A desktop hydrologic evaluation of the watercourse crossings was undertaken involving delineation of watershed boundaries, calculation of drainage areas, channel lengths and slopes, and runoff volumes. Watercourses that were crossed more than once, either by a combination of the highway, an access road or have an existing crossing, required a single hydrologic evaluation.

Water quality data collected include temperature, dissolved oxygen, nitrate + nitrite, ammonia, pH, chloride, sulfate, turbidity, sodium, calcium, iron, manganese, copper, and zinc. Rock samples were obtained and analysed to determine potential for sulfide bearing rock drainage.

With respect to culvert and bridge installations, the *Fisheries Act* (Section 35) requires the protection of fish habitat in all watercourses that bear fish. This is administered in the province of New Brunswick by the *Watercourse Alteration Regulation* and the *Clean Water Act*. Applications will be made for *Watercourse and Wetland Alteration Permits*. This application process applies to all activities (construction of watercourses, clearing, repairing and maintenance) within 30 m of a watercourse. Watercourse crossings will be installed according to the *Watercourse Alteration Technical Guidelines* developed by NBDELG (2002b). In addition, all watercourse crossings of more than 1.2 meters in diameter and/or more than 25 meters in length, and/or with a slope above 0.5% will follow the *Guidelines for the Protection of Fish and Fish Habitat – The Placement and Design of Large Culverts* (DFO 1999).



It is the professional judgement of the study team that the data that are available to characterize the existing conditions and the existing knowledge regarding the Project-VEC interactions are sufficient to support the EA.

5.3.3 Residual Environmental Effects Rating Criteria

A *significant residual environmental effect* on Surface Water quality is one that causes a long-term (*i.e.*, 30 days or more). Project related exceedance of the CCME guidelines for the protection of aquatic life or recreation (CCME 1999).

According to CCME (1999) during clear flow periods, anthropogenic activities should not increase suspended sediment concentrations by more than 25 mg/L over background levels during any short-term exposure period (*i.e.*, 24 hours or less). For long term exposure (*i.e.*, 30 days or more), average suspended sediment concentrations in clear systems should not be increased by more than 5 mg/L over background levels.

In clear streams, small induced exceedances in suspended sediment concentrations above 25 mg/L change from background levels for short term exposures (*e.g.*, 24 hours) are likely to cause behavioural and low sublethal effects on fish, all of which are reversible. Based on extrapolation from severity-of-ill-effects analysis, a long-term exposure guideline has been set at an average suspended sediment change in 5mg/L (*e.g.*, for exposures lasting 30 days). This exposure translates to minor physiological stress and increased rates of coughing and respiration for the most sensitive group of aquatic organisms (CCME 1999a).

A *significant residual environmental effect* on Surface Water quantity is one that changes the quantity of Surface Water such that fish habitat is temporarily lost or avoided and natural recruitment would not re-establish the community to its original composition, density and extent in one generation.

5.3.4 Existing Conditions

The proposed TCH will be constructed west of the existing TCH through an area dominated by steep hills and valleys. A total of forty-three watercourses along the 70 km length of the proposed TCH have been assessed. A number of other watercourses were identified in maps but were not found during the field surveys.

There are three lakes located within 500 m of the alignment - Leith Lake (Figure 3.2B, Appendix C), Reid Lake (Figure 3.2B, Appendix C), and Bishops Lake (Figure 3.2A, Appendix C). Bishops Lake is a spring fed lake that is 100 m east and on a watercourse that is upstream of the proposed TCH. Reid Lake is approximately 450 m west on a watercourse not crossed by the proposed TCH. Leith Lake is



100 m east and is downstream, but is not on a watercourse that will be directly affected by the Project. In addition to lakes within 500 m of the alignment, Ketch Lake and Payson Lake are considered to be environmentally significant areas (ESA) within the zone of influence of the Project (Guidelines, Appendix A). Ketch Lake is 1.7 km west of the proposed TCH RoW. Ketch Lake drains to Two Mile Brook, which is a tributary of Big Presque Isle Stream. Two Mile Brook is upgradient and upstream of any Project activities. Payson Lake is 3.5 km west of the proposed TCH, just north of the town of Woodstock. There are no anticipated interactions between the Project and these lakes, therefore the lakes are not characterized in this section and they are not carried forward in the environmental assessment.

The character of the surrounding country changes from north to south along the alignment. In general, the northern section between Perth-Andover and Florenceville has more topographic relief and is more forested. The southern section between Florenceville and Woodstock is a region of rolling hills and plateaus that has been extensively cleared and is now used primarily for agriculture and grazing. The existing land use conditions are described in more detail in Section 5.8.4.

5.3.4.1 Hydrology

The hydrology of the watercourses in the vicinity of the Project is determined primarily by the climatic conditions and the topography of both the Project RoW and the watersheds that are intersected. In determining the potential environmental effects of the Project on the local watercourses, qualitative and quantitative observations have been made.

Factors such as watershed drainage area, channel and basin slopes, and the fraction of each watershed that is covered in lakes are important quantitative measurements to consider in the evaluation of proposed watercourse crossings. Table 5.3.1 presents a summary of these physiographic characteristics for the 43 watercourse crossings that were identified along the alignment. These streams are numbered from 1 to 43 in this CSR and are shown on Figures 3.2A-D, Appendix C.

5.3.4.2 Existing Climate

The mean annual precipitation (MAP) for the Project RoW is approximately 1000 mm per year and the mean annual runoff (MAR) is approximately half of that at 500 mm per year (Acres 1977). Environment Canada rainfall data exists for the St. John River Valley (Fredericton and Saint-Leonard). In Fredericton, 24 hour rainfalls with return periods of 50 and 100 years are estimated at 102.3 mm and 111.3 mm, respectively (Environment Canada, unpublished data). For Saint-Leonard, 24 hour rainfalls with return periods of 50 and 100 years are estimated at 93.5 mm and 102.0 mm, respectively (Environment Canada, unpublished data). Peak flows are typically observed during the spring freshet while the lowest flows are typically observed during the dry summer months. A few of the Project watercourse crossings (*i.e.*, WC21 – Tributary to Upper Guisguet Brook, WC23 – Tributary to Lower



Guisguait Brook and WC34 – Tributary to Big Presque Isle Stream) are expected to be intermittent as there may be no streamflow in the steep small watersheds during summer months with prolonged periods of drought.

5.3.4.3 Climate Change

The following climate information is extracted from a background paper titled *Water Sector: Vulnerability and Adaptation to Climate Change* which was presented during a Canadian Society of Civil Engineering conference held in Moncton, New Brunswick, May 11 to 12, 2000 (GCSI and MSC 2000). This document was prepared with support from the Climate Change Action Fund, National Resources Canada with authors from Global Change Strategies International Inc. (GCSI) and the Meteorological Service of Canada (MSC).

The above document discusses the climate trends associated with an increase in the global mean temperature due to increased greenhouse gases in the atmosphere (particularly carbon dioxide, CO₂). The trends are based on General Circulation Models or Global Climate Models (GCM's) that have been developed in Canada, U.S.A., U.K., and Germany. These models anticipate that the concentration of CO₂ in the atmosphere will double between the year 2000 and the year 2050.

The following relevant statements that were extracted from the document are presented below.

- For a doubled CO₂ atmosphere, by the second half of the coming century, temperature increases for summers, over Canada, as projected would average about 4°C. For winter months (Dec, Jan, Feb) increases of 6°C or more are projected for most of central Canada, with slightly lower values in the east and west.
- A winter precipitation increase of 0 to 20% is projected for Atlantic Canada.
- In summer, only small increases in precipitation are projected for Atlantic Canada.
- Nationally, precipitation has increased 1.7% of the mean per decade over the period 1948 to 1985.





Table 5.3.1 Summary of Watershed Physiographic Characteristics for Project Crossings

WC ID#	Watercourse Crossing Name*	Drainage Area (km ²)	Drainage Length (km)	Channel Length (km)	Avg Basin Slope (%)	Crossing Slope (%)	Lake Area (%)
1	Wark Brook	6.01	4.13	3.8	4.72	3.03	0
2	Tributary to Saint John River	0.87	1.34	0.84	10.67	5.17	0
3	Tributary to Saint John River	0.90	1.82	1.18	8.9	2.94	0
4	Tributary to Saint John River	0.91	1.30	0.72	8.08	5.00	0
5	Tributary to Saint John River	0.49	1.13	0.37	13.70	5.00	0
6	Tributary to Saint John River	0.91	1.89	0.86	9.37	12.50	0
7	Plant Brook	0.85	1.65	1.21	13.15	9.38	0
8	Demerchant Brook	0.88	1.71	1.37	13.45	17.65	0
9	Bryson Brook	0.57	1.60	0.62	11.25	7.14	0
10	Tributary to Brown Brook	0.87	2.14	1.47	7.73	3.33	0
11	Tributary to Brown Brook	0.34	1.24	0.35	11.94	12.50	0
12	Tributary to Brown Brook	0.78	1.92	1.21	8.18	6.25	0
13	Tributary to Brown Brook	0.37	1.56	0.23	9.17	7.69	0
14	Graham Brook (Access Rd. D)	0.81	1.49	0.94	8.26	4.55	0
15	Graham Brook (outflow from Bishop Lake)	0.40	0.92	0.21	0.6	0.6	6.9
15e	Graham Brook (existing lower road)	0.55	1.47	1.43	0.68	3.12	7.26
16	Graham Brook	3.78	3.57	3.20	4.90	1.30	1.91
17	Tributary to River de Chute/McMullin Brook (Access Rd. F)	0.22	1.00	0.04	9.00	8.33	0
18	River de Chute	75.4	15.1	13.9	0.59	2.66	0.08
19	Tributary to Upper Guisguait Brook	1.24	1.64	0.35	3.96	2.63	5.26
20	Upper Guisguait Brook	37.1	12.8	11.8	0.82	0.97	3.78
21	Tributary to Upper Guisguait Brook	0.08	0.60	0	7.00	4.00	0
22	Tributary to Lower Guisguait Brook	1.91	2.54	1.62	2.36	0	4.84
23	Tributary to Lower Guisguait Brook	0.60	1.49	0.55	3.83	6.67	0
24	Lower Guisguait Brook/Tributary to Lower Guisguait Brook	29.5	10.2	7.72	1.64	0.77	0.99





Table 5.3.1 Summary of Watershed Physiographic Characteristics for Project Crossings

WC ID#	Watercourse Crossing Name*	Drainage Area (km ²)	Drainage Length (km)	Channel Length (km)	Avg Basin Slope (%)	Crossing Slope (%)	Lake Area (%)
25	Tributary to Lower Guisiguit Brook	4.98	4.31	3.31	2.92	1.43	0.42
26	Tributary to Lower Guisiguit Brook	1.06	1.15	0.09	2.61	0	5.28
27	Tributary to Lower Guisiguit Brook	0.41	1.00	0.12	8.00	0	11.3
28	Tributary to Leith Lake Drainage	0.87	2.32	1.35	3.75	3.70	0.83
29	Headwaters to Leith Lake Drainage	0.41	1.25	0*	6.10	0.77	0
30	Tributary 3 to Hunters Brook	1.18	2.18	0.44	1.97	0.54	0
31	Tributary 2 to Hunters Brook	2.58	3.53	1.75	1.47	1.20	0
32	Hunter Brook (Access Rd. J)	16.72	7.82	6.75	2.02	0.63	0.11
33	Big Presque Isle Stream	585	52.3	51.6	0.25	0.16	0.57
34	Tributary to Big Presque Isle Stream	1.81	2.54	2.24	1.29	2.34	1.36
35	Tributary to Little Presque Isle Stream	3.15	3.74	2.62	2.06	0.31	1.20
36	Little Presque Isle Stream	134.8	30.9	29.2	0.22	0.17	3.52
37	Little Presque Isle Stream	119.3	27.9	26.2	0.23	0.17	3.88
38	Lanes Creek	2.41	3.05	2.46	2.82	0.81	1.31
39	Tributary to Harper Brook	0.34	1.46	0.38	2.95	0.71	0.64
40	Tributary to Harper Brook	0.26	1.07	0.23	2.24	1.37	0.93
41	Tributary to Harper Brook	2.37	3.43	2.70	2.85	1.15	0.03
42	Harper Brook	2.70	2.53	2.08	3.75	1.05	0.04
43	Tributary to the Meduxnekeag	1.04	1.32	1.22	0.76	0.71	3.17

*refer to Figure 3.2 A-D, Appendix C for watercourse locations.



- No analyses of Canadian data are available of trends in very short duration (minutes to hours) heavy rain events which cause city street flooding, sewer overflows, erosion and flash floods, and landslides, but some analyses of heavy one-day events have been undertaken. These show that there has been an increase in precipitation in heavy events in Atlantic Canada.
- Model results indicate that there will be an increased frequency of heavy one-day rains in a doubled CO₂ climate, with return periods halved, (e.g., a 20 year return period rainfall becomes a 10 year event).
- The Canadian GCM indicates that in a doubled CO₂ world, the number of weak to moderate winter storms in the northern hemisphere would decrease but the number of very severe storms would increase.
- If the frequency of short duration high precipitation intensities increase as projected, then greater soil erosion and sedimentation is likely, and more pollutants may be washed into rivers and lakes due to urban runoff.

The above information, in particular the change in the return period of storm events, should be considered during the design of the watercourse structures. Based on the information presented above, what is presently considered to be a 100 year return period rainfall (based on frequency analyses using historic data) would become a 50 year event by the year 2050.

5.3.4.4 Watercourse Characterization

The topographic conditions along the Project alignment range from mildly sloping terrain near Lower Waterville (WC38, WC39 and WC40), to steep and flashy mountainous terrain between Perth-Andover and Bairdsville (WC1 to WC15) (Figure 3.2A-D, Appendix C). The watercourses with steep basin slopes tend to have little storage and can be flashy with high flood flow magnitudes. These channels are often incised and have an increased potential for ice and debris jams. An increased potential for ice and debris jams also exist where channel slopes change from steep to mild, immediately upstream of a crossing (i.e., WC3 – Tributary to Saint John River).

A brief summary of each of the 43 watercourse crossings (Figure 3.2A-D, Appendix C), is presented in the following paragraphs. The study team conducted field reconnaissance at each of these streams to support this description. The description identifies hydrotechnical issues and recommendations for design and construction including topography, bank stability, potential for erosion and type of structure.

Figure 3.2A, Appendix C

WC1 Wark Brook is located near the Perth-Andover limits, this watercourse has a large drainage area (6.01 km²) upstream of the Project RoW. The proposed crossing has a steep southern bank, which presents potential erosion and sediment control issues. A man-made salmon pond, which diverts flow



from Wark Brook, is located at the north bank. Approximately 100 m downstream of the RoW is the existing TCH, which is crossed by a 3.0 m diameter culvert.

WC2 Tributary to Saint John River is located 500-600 m west of the existing TCH, the small watershed (0.87 km^2) for this watercourse crossing is very steep (10.7% average basin slope) and flashy. No specific hydrotechnical concerns were identified for this crossing.

WC3 Tributary to Saint John River is located 700 m west of the existing TCH near Hillandale, the small watershed (0.90 km^2) for this watercourse crossing is very steep (8.90% average basin slope) and flashy with an increased ice/debris jam potential, as indicated by the incised channel and the change in channel slope from steep to mild immediately upstream of the crossing. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC4 Tributary to Saint John River is located 800 m west of the existing TCH, this watercourse crosses Beaconsfield Road (north to south) at the Project RoW and flows east along the ditch to the existing TCH. The small watershed (0.91 km^2) is very steep (8.08% average basin slope), but does not appear to have an increased flooding potential.

WC5 Tributary to Saint John River is located south of Beaconsfield Road and 1 km west of the existing TCH, the small watershed (0.49 km^2) for this watercourse crossing is very steep (13.70% average basin slope), but does not appear to have an increased flooding potential.

WC6 Tributary to Saint John River is located 700 m west of the existing TCH, this watercourse has a small drainage area (0.91 km^2) upstream of the Project location. The proposed crossing is very steep (12.5 % channel slope), with steep banks that indicated the potential for erosion and sediment movement during construction. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep, slightly incised channel.

WC7 Plant Brook is located 350 m west of the existing TCH, this watercourse has a small drainage area (0.85 km^2) upstream of the Project location. The proposed crossing is very steep (9.38% channel slope), with flow occurring in pool/riffle sequences. Steep slopes and an incised channel indicate an increased potential for ice/debris jams at the crossing.

WC8 Demerchant Brook is located 200 m west of the existing TCH, this watercourse has a small drainage area (0.88 km^2) upstream of the Project location. The proposed crossing is very steep (17.65% channel slope), with flow occurring in pool/riffle sequences. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep incised channel.



The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC9 Bryson Brook is located 500 m west of the existing TCH, this watercourse has a small (0.57 km^2), primarily wooded watershed upstream of the Project location. The proposed crossing is steep (7.14 % channel slope), with flow occurring in pool/riffle sequences. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep incised channel. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC10 Tributary to Brown Brook is located 1.1 km west of the existing TCH and east of Beaconsfield Road, this watercourse has a small (0.87 km^2), primarily wooded watershed upstream of the Project location. Streamflow occurs in pool/riffle sequences, while well-vegetated floodplains exist along the channel banks. The field inspections indicate no specific hydrotechnical concerns at this location.

WC11 Tributary to Brown Brook is located 1.5 km west of the existing TCH and east of Beaconsfield Road, this watercourse has a small (0.34 km^2), primarily wooded watershed upstream of the Project location. The proposed crossing is steep (12.5 % channel slope), with flow occurring in pool/riffle sequences. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep incised channel. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC12 Tributary to Brown Brook is located 1.7 km west of the existing TCH and east of Beaconsfield Road, this watercourse has a small (0.78 km^2), primarily wooded watershed upstream of the Project location. The proposed crossing is fairly steep (6.25 % channel slope), with flow occurring in pool/riffle sequences. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep incised channel. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC13 Tributary to Brown Brook is located 1.9 km west of the existing TCH and east of Beaconsfield Road, this watercourse has a small (0.78 km^2), primarily wooded watershed upstream of the Project location. The proposed crossing is steep (7.69% channel slope), with flow occurring in pool/riffle sequences. The field inspections indicate that the watershed is very flashy with an increased potential for ice/debris jams due to the steep incised channel.

WC14 Graham Brook (access road D) is located 3 km west of the existing TCH; this watercourse crossing is located at access road D, off the Beaconsfield Road. The small watershed (0.81 km^2) for this watercourse crossing is steep (8.26% average basin slope), but does not appear to have an increased flooding potential. No specific hydrotechnical concerns were identified for this crossing.



WC15 Graham Brook (outflow from Bishop Lake) is located 2 km west of the existing TCH at the outlet from Bishop Lake, this watercourse has a small (0.40 km^2) watershed that is mainly routed through Bishop Lake (surface area 0.03 km^2). The crossing has steep banks on both sides, which have been deforested to the edge of the watercourse near the westbound lane. This is indicative of the potential for sediment laden runoff to enter the watercourse during construction. Significant beaver activity was observed at the crossing as the very mild channel and basin slopes (0.6% each) combined with the steep banks create a prime location for damming the watercourse.

WC15e (existing road) Graham Brook is located west of the Project RoW, this watercourse flows under Scott Road through a 0.9 m diameter culvert. At the upstream end of the culvert is a wetland that is impounded by the road. This section of Scott Road is proposed to be realigned during construction, with the new crossing to be located immediately downstream of the existing crossing. No specific hydrotechnical concerns were identified for this crossing.

WC16 Graham Brook is located 1.5 km west of the existing TCH, south of Scott Road and downstream of the outlet from Bishop Lake (watercourse 15), this watercourse crossing has significant beaver activity in the mildly sloped channel. Although the watershed has a fair sized drainage area (3.78 km^2), the upstream storage at Bishop Lake and Scott Road combined with the local beaver activity create the appearance of a small streamflow in the poorly defined, braided channel. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC17 Tributary to River de Chute/McMullin Brook is located 2.1 km west of the existing TCH and 0.5 km north of Route 560, this watercourse crossing is located at access road F, which connects to Dean Road to the north. The watercourse has a small watershed (0.22 km^2), as the crossing is located only 40 m from the upper end of the channel. The slope of the channel at the crossing is steep (8.26%), but the terrain and small watershed do not indicate an increased flooding potential. No specific hydrotechnical concerns were identified for this crossing.

Figure 3.2B, Appendix C

WC18 River de Chute is located 1.3 km west of the existing TCH along Route 560; this watercourse crossing has a significant watershed (75.4 km^2) that extends into Maine. There are very few lakes and wetlands (0.08% of the drainage area) upstream of the crossing to provide storage. The south bank is steep and high with a high potential for sediment laden runoff to enter the watercourse during construction. Channel bank erosion and scarring was observed during field inspections, providing evidence of ice movement and indicating the potential for ice or debris jams at the crossing. A bridge or spanning structure is recommended for this crossing.



WC19 Tributary to Upper Guisguilt Brook is located 1.6 km west of the existing TCH, the watershed (1.24 km²) upstream of the Project RoW is primarily wooded and well-vegetated. At the crossing location the channel is well defined with no specific hydrotechnical concerns identified during the field inspections.

WC20 Upper Guisguilt Brook is located 2.1 km west of the existing TCH; this watercourse has a significant watershed (37.1 km²) that extends into Maine. Approximately 30 m upstream of the Project RoW is a confluence that presents the potential for ice/debris jams at the crossing. During the field inspections, it was observed that significant beaver activity at the crossing had resulted in a 30 m wide, 0.5-1.0 m deep marsh area. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction. Based on the large watershed area, the potential for high flows at this crossing, and the good aquatic habitat, a spanning structure is recommended.

WC21 Tributary to Upper Guisguilt Brook is located 2.2 km west of the existing TCH; this watercourse is not shown on 1:10,000 scale mapping to be crossed by the Project RoW. The upper end of the watercourse is shown at the westbound lane edge of the RoW, but field inspections did not reveal a channel or flow during the dry summer conditions.

WC22 Tributary to Lower Guisguilt Brook is located 2.2 km west of the existing TCH and north of Stairs Road, this watercourse has a watershed (1.91 km²) that is mainly routed through wetlands located 40 m upstream. Outflow from the wetlands flows through an old culvert that has been partially blocked by beaver activity, causing the road to wash out. Steep banks on both sides of the watercourse indicate a high potential for sediment laden runoff to enter the watercourse during construction.

WC23 Tributary to Lower Guisguilt Brook is located 2.5 km west of the existing TCH and south of Stairs Road, this watercourse has a small (0.60 km²) watershed that flows between the proposed east and westbound lanes. Construction along the present Project alignment would likely eliminate 500 m of the watercourse. Field inspections revealed a dry, well defined, incised channel indicating that the watercourse is intermittent but likely conveys high flood flows during wet conditions (i.e., spring freshet).

WC24 Lower Guisguilt Brook is located 2.5 km west of the existing TCH and north of the B Smith Road and A Brown Road intersection, this watercourse has a significant watershed (29.5 km²) which includes flow from watercourse 22. Upstream of the crossing, in the Upper Knoxford area, are Reid Lake and Lawrence Lakes. Although there is little evidence of ice scarring, the small tributary located 40 m upstream of the Project RoW indicates an increased potential for ice/debris jams at the crossing. Based on the large watershed area, the potential for high flows at this crossing, and the good aquatic habitat, a spanning structure is recommended.



WC25 Tributary to Lower Guisguilt Brook is located 3.5 km west of the existing TCH and south of the B Smith Road, this watercourse collects flow from a fair sized (4.98 km^2) watershed which includes flow from watercourses 26 and 27. There is a wide, well-vegetated floodplain, but the main channel is difficult to define as a result of beaver activity. High flood flows are not expected due to the flood flow storage in the upstream wetlands.

WC26 Tributary to Lower Guisguilt Brook is located west of the existing TCH, between Back Greenfield and Summerfield Road; the crossing is through a wooded wetland area, without a well defined main channel. The Project length is approximately 300 m through the wetland, with beaver activity observed throughout. No specific hydrotechnical concerns were identified for this crossing.

WC27 Tributary to Lower Guisguilt Brook is located west of the existing TCH, between Back Greenfield and Summerfield Road; the crossing location is in a wooded wetland area. There are many small channels, but no well defined main channel. The Project length is approximately 350 m through the wetland, with beaver activity observed throughout. No specific hydrotechnical concerns were identified for this crossing.

WC28 Tributary to Leith Lake Drainage is located west of the existing TCH and southeast of Wakem Corner, this watercourse collects runoff from a small area (0.87 km^2) upstream of the Project RoW. The channel is fairly defined with a well-vegetated floodplain on each side. The channel bottom is silt with flow occurring in pool/riffle sequences caused mainly by roots and fallen trees. No specific hydrotechnical concerns were identified for this crossing.

WC29 Headwaters to Leith Lake Drainage collects surface runoff from a small area (0.41 km^2) upstream of the Project RoW. The 1:10,000 scale mapping shows the upper end of this watercourse to be located at the westbound lane centreline. Field inspections revealed this section of the small watershed to be marshy with a poorly defined channel. No specific hydrotechnical concerns were identified for this crossing.

Figure 3.2C, Appendix C

WC30 Tributary to Hunters Brook crossing collects runoff from the proposed Highway 110 interchange. The 440 m channel length that comprises the upper end of the watercourse is completely within the footprint of the proposed interchange.

WC31 Tributary to Hunters Brook is located west of Highway 103 and east of Highway 110, the Tributary 2 to Hunters Brook crossing has a watershed (2.58 km^2) that is mainly farmland drainage. The channel slope is mild (1.20%), and no specific hydrotechnical concerns were identified during the field inspections.



WC32 Hunters Brook crossing is located at access road J. This large watershed (16.7 km²) drains to Big Presque Isle Stream, located upstream of the Project RoW. At the Hunters Brook crossing location, the channel is well defined with a mild slope (0.63%). The steep northwest bank has a high potential for sediment laden runoff to enter the watercourse during construction. Standard erosion and sediment control measures are not expected to be adequate mitigation for the sediment laden runoff. Special attention should be paid to the site layout during design of the crossing.

WC33 Big Presque Isle Stream is the most substantial of the watercourse crossings with a 585 km² drainage area that extends well into Maine. This is the only watercourse among the 43 crossings that has an Environment Canada hydrometric station (located upstream at Tracey Mills) to gauge the flow. At the RoW, the stream is approximately 30 m wide, with steep banks on each side. Field inspections revealed the crossing to be located on a bend with signs of ice scour on the outside bank. The steep banks near the crossing indicate a high potential for sediment laden runoff to enter the watercourse during construction. Based on the steep banks, the very large watershed, and anticipated high flood flows, a bridge is recommended for this crossing.

WC34 Tributary to Big Presque Isle Stream is located 300 m south of Dryer Road. Marsh areas upstream of the crossing provide storage with no outflow during dry summer conditions. During field inspections, the dry channel could not be located. No specific hydrotechnical concerns were identified for this crossing.

Figure 3.2D, Appendix C

WC35 Tributary to Little Presque Isle Stream crossing is located at the upstream edge of a marsh. At the RoW, the channel is poorly defined with a silt bottom as the water appeared stagnant during field inspections. The mildly sloped upstream channel connects four (4) smaller marsh areas to form a basin with significant storage upstream of the Project RoW. No specific hydrotechnical concerns were identified for this crossing.

WC36 Little Presque Isle Stream crossing (Connector Road to Hartland) is located between Stockford and Somerville, 450 m west of the existing TCH. The large watershed (135 km²) includes Williamstown Lake and a number of smaller lakes that comprise 3.5% (4.6 km²) of the drainage area. Channel bank erosion and scarring were observed during field inspections, providing evidence of ice movement and indicating the potential for ice or debris jams at the crossing. The steep east bank indicates a high potential for sediment laden runoff to enter the watercourse during construction. Based on the large watershed and the potential for high flood flows, a bridge or spanning structure is recommended for this crossing.



WC37 Little Presque Isle Stream crossing of the Little Presque Isle Stream is located upstream of watercourse 36 at the Waterville Deadwater, near Estey Road. Like watercourse 36, this large watershed (119 km²) includes Williamstown Lake and a number of smaller lakes to comprise 3.9% (4.7 km²) of the drainage area. The channel slope at the proposed crossing location is very flat (0.17%) and has the impression of water being stagnant. No specific hydrotechnical concerns were identified for this crossing. Based on the large watershed and the good aquatic habitat, a bridge or spanning structure is recommended for this crossing.

WC38 Lanes Creek is located 800 m west of the existing TCH at Lower Waterville, this watercourse crossing has a fair drainage area (2.41 km²) that is mostly gently sloped farmland. The channel is well defined with well-vegetated floodplain. The marsh located on one (1) of the upstream branches, and a sandy channel bottom, indicate low flood flows. No specific hydrotechnical concerns were identified for this crossing.

WC39 Tributary to Harper Brook is located 600 m west of the existing TCH, this watercourse crossing has a very small drainage area (0.34 km²) upstream of the RoW. The proposed crossing is located 300 m downstream of a very small marsh area. No flow or main channel could be identified during the field inspections as it is expected that flow occurs through the mossy ground during summer low flow conditions. No specific hydrotechnical concerns were identified for this crossing.

WC40 Tributary to Harper Brook is located 800 m west of the existing TCH, this watercourse crossing has a very small drainage area (0.26 km²) upstream of the RoW. The proposed crossing is shown to be located between two (2) small marsh areas but no channel or flow was observed during the field inspections. No specific hydrotechnical concerns were identified for this crossing.

WC41 Tributary to Harper Brook crossing is located 600 m west of the existing TCH. Much of the 2.37 km² watershed is farmland with gently sloped terrain. The 1 m wide channel has a fairly mild slope (1.15%) and well-vegetated banks. No specific hydrotechnical concerns were identified for this crossing.

WC42 Harper Brook crossing is located 350 m west of the existing TCH. Much of the 2.70 km² watershed is farmland with gently sloped terrain. Approximately 40 m upstream of the eastbound lane is a small tributary, which poses potential ice jam problems. This should be considered during the design process.

WC43 Tributary to Meduxnekeag River crossing is located near Woodstock at the existing TCH, north of the Route 550 interchange. This crossing has marsh on both the upstream and downstream sides of the RoW, which are connected by a 0.9 m diameter corrugated steel culvert. There is sufficient storage on the upstream side of the culvert to attenuate peak flows from the 1.04 km² watershed. No specific



hyrotechnical concerns were identified for this crossing. Although the main channel of the Meduxnekeag is not crossed by the Project, there is an Environment Canada hydrometric station near Belleville that may be used to assess hydrological conditions in the southern portion of the Project area.

5.3.4.5 Surface Water Quality

5.3.4.5.1 General Chemistry

Surface water samples were obtained from the watercourse crossings to determine general surface water quality within the zone of influence of the Project, and are presented in Table 5.3.2. General chemistry analysis for parameters such as temperature, dissolved oxygen, pH, nitrate + nitrite, ammonia and turbidity for the most part indicated good surface water quality conditions. Dissolved oxygen concentrations in Watercourses 15e, 26, 27 and 29 were below the minimum acceptable concentration according to CCME (1999a) guidelines for the protection of freshwater aquatic life. Iron concentrations in samples obtained in watercourses 15, 26 and 27 exceeded the CCME guideline for the protection of aquatic life. In general, water quality is good in the surface waters throughout the Project area.

Tables 5.3.3 and 5.3.4 summarize applicable *Environment Canada Water Quality Guidelines* (CCME 1999a).

5.3.4.5.2 Geological Interpretation

The geological information for this work was obtained from the Geological Map of New Brunswick, Map NR-1, second edition, dated 1979. The bedrock within the entire Assessment Area is contained within one geological unit. The bedrock is of Upper Ordovician or Lower Silurian in age and described as a thinly bedded limestone, calcareous shale, or a feldspathic sandstone that was deposited in a deep marine basin. Only one major fault crosses through the Assessment Area and it is located within the area just south of Perth-Andover. Based on the bedrock geology, sulfide sulfur bearing rock is expected within the Assessment Area, however, the bedrock is also expected to have a high neutralizing potential as well.

5.3.4.5.3 Sulfide Bearing Rock Drainage Potential

As part of the overall EA of the proposed TCH, issues related to potential sulfide bearing rock drainage have been reviewed. The concern with the sulfide bearing rock drainage potential comes from the fresh exposure of bedrock as a result of the highway construction where the grades require bedrock exposure and excavation.





Table 5.3.2 Water Quality Results

Parameter Concentration (as mg/L)																
WC ID#	Sodium	Calcium	Iron	Manganese	Copper	Zinc	Ammonia (total)	pH	Chloride	Sulfate	Nitrate + Nitrite (as N)	Turbidity	Dissolved Oxygen	Temperature	Northing (19T)	Easting (19T)
1	1.72	31.4	<0.02	0.004	<0.001	<0.001	<0.05	7.9	1.1	7	0.83	0.8	6.3	12	597658.2	5176161
2	1.86	7.29	0.04	0.005	<0.001	0.001	<0.05	7.4	<0.05	5	<0.05	9.2	6.7	11.5	596956.7	5174791
3	1.82	10.1	0.03	0.006	<0.001	0.007	<0.05	7.0	<0.05	6	<0.05	3.2	8.3	14	596644.1	5173775
4	4.84	25	0.04	0.008	<0.001	<0.001	<0.05	7.6	6.4	8	0.49	1.6	8.9	11	596453	5173017
5	1.85	15.6	<0.02	0.001	<0.001	<0.001	<0.05	7.4	<0.05	6	0.15	0.5	8.3	15	596383	5172142
6	1.17	11.8	<0.02	<0.001	<0.001	<0.001	<0.05	7.4	<0.05	3	0.05	1	8.0	16	596660	5171450
7	1.71	12.9	<0.02	0.005	<0.001	<0.001	<0.05	7.5	<0.05	4	0.07	0.2	9.2	14	597024	5170609
8	1.74	9.53	<0.02	<0.001	<0.001	<0.001	<0.05	7.3	<0.05	4	0.12	0.1	7.5	14	597225	5169096
9	1.5	20.9	0.02	0.004	<0.001	<0.001	<0.05	8.1	1	4	0.14	1.4	7.8	15	597035	5168196
10	1.6	14.9	<0.02	0.001	<0.001	<0.001	<0.05	7.4	<0.05	4	<0.05	0.2	7.8	15	596473.3	5167357
11	1.3	19.2	<0.02	0.004	<0.001	0.0017	<0.05	7.7	<0.05	5	<0.05	0.2	8.1	12	596258.4	5166695
12	1.72	8.79	<0.02	<0.001	<0.001	<0.001	<0.05	7.4	<0.05	5	0.08	0.3	7.9	15	596187.9	5166483
13	1.52	11.8	0.06	0.004	<0.001	0.009	<0.05	7.5	0.5	4	0.05	2.5	7.1	16	596114.2	5166189
14a	4.78	16.3	<0.02	0.003	<0.001	<0.001	<0.05	7.6	8.2	5	0.68	0.2	6.9	13	595164.7	5165072
15e	0.99	26.5	0.16	0.022	<0.001	<0.001	<0.05	7.9	0.6	2	<0.05	1.3	5.3	24	596376.9	5164846
15	1.4	34.1	0.47	0.11	<0.001	<0.001	<0.05	8.1	1	4	0.14	1.4	6.4	21	596191.8	5164295
16	3.1	40.8	0.03	0.03	<0.001	<0.001	<0.05	8	6	2	0.25	1	8.2	11	596636	5163864
17a	1.57	30.5	<0.02	0.001	<0.001	<0.001	<0.05	7.8	1.3	4	0.56	0.5	6.5	10	595556	5161406
18	2.42	45.8	<0.02	0.003	<0.001	<0.001	<0.05	8	4.4	7	0.18	0.5	7.8	14	596356	5160738
19	1.2	65.5	<0.02	0.001	<0.001	<0.001	<0.05	8	6.8	6	5	0.2	8.2	9	596139.8	5159218
20	2.66	52.2	0.07	0.04	<0.001	<0.001	<0.05	7.9	7.5	7	0.57	4.8	7.2	17	595940.3	5157982
21†	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	596077.8	5157558
22	1	56.7	0.04	0.052	<0.001	<0.001	<0.05	8	2.2	6	0.12	0.6	7.0	18	596858.9	5156202
23†	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	598455.6	5155151
24	2.38	56.9	0.06	0.01	<0.001	<0.001	<0.05	8.1	8.8	6	0.85	1.7	7.2	18	598822.5	5154873
25	2.98	67	0.04	0.011	<0.001	<0.001	<0.05	8	9.5	6	1.82	0.4	5.9	16	599531.9	5153760





Table 5.3.2 Water Quality Results

WC ID#	Parameter Concentration (as mg/L)											Easting (19T)	Northing (19T)	Temperature
	Sodium	Calcium	Iron	Manganese	Copper	Zinc	Ammonia (total)	pH	Chloride	Sulfate	Nitrate + Nitrite (as N)	Turbidity	Dissolved Oxygen	
26	1.07	56.8	0.75	1.94	<0.001	<0.001	0.06	7.7	1.1	<1	<0.05	1.6	0.9	599793.9
27	2.12	55.1	0.58	0.501	<0.001	<0.001	<0.05	7.5	6.6	<1	<0.05	2.1	4.6	600091
28	2.23	52.4	0.03	0.017	<0.001	<0.001	<0.05	7.9	11.1	10	3.3	0.5	6.7	601804.2
29	2.5	61.9	0.21	0.152	<0.001	<0.001	<0.05	7.4	14.2	14	4.35	3.7	3.4	601919.4
30	n/d	67.4	n/d	n/d	n/d	n/d	n/d	7.9	n/d	n/d	n/d	n/d	n/d	603615.5
31	n/d	62	n/d	n/d	n/d	n/d	n/d	7.9	n/d	n/d	n/d	n/d	n/d	603940.4
32a	4.67	63.7	<0.02	0.006	<0.001	0.001	<0.05	8.1	14	7	0.97	0.4	8.4	603362.9
33	5.09	45	<0.02	0.004	<0.001	<0.001	<0.05	7.9	7	9.7	0.13	0.4	n/d	604504
33*	4.39	53.1	0.051	0.016	<0.0005	<0.005	0.011	8.22	9.82	10.6	0.88	1.0	n/d	unknown
34	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	605101.2
35	n/d	48.3	n/d	n/d	n/d	n/d	n/d	7.8	n/d	n/d	n/d	n/d	n/d	609111.5
36e	3.84	49.8	0.11	0.031	<0.001	<0.001	<0.05	7.7	10.3	8	0.52	0.8	n/d	61018.7
37	2.67	47.9	0.05	0.029	<0.001	<0.001	<0.05	7.9	7	7.6	0.41	0.4	n/d	608908.2
38	n/d	56	n/d	n/d	n/d	n/d	n/d	7.5	n/d	n/d	n/d	n/d	n/d	608209.2
39	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	608123.7
40	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	607894.8
41	n/d	77.3	n/d	n/d	n/d	n/d	n/d	8	n/d	n/d	n/d	n/d	n/d	607789.7
42	n/d	75.7	n/d	n/d	n/d	n/d	n/d	8	n/d	n/d	n/d	n/d	n/d	607910.5
43	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	607372.3

Notes:

bold values exceed CCME guidelines for freshwater aquatic life (CCME 1999)

* indicates sample and data collected by the province of New Brunswick; † dry channel at time of sampling

n/d = not determined; n/c = not collected



Table 5.3.3 Canadian Water Quality Guidelines

Parameter	Aquatic Life Freshwater	Agriculture	
		Irrigation	Livestock
Sodium	n/e	n/e	n/e
Calcium	n/e	n/e	1000
Iron	0.3	5	n/e
Manganese	n/e	2	n/e
Copper	0.002	0.2-1	0.5-5
Zinc	0.03	1-5	50
pH	6.5-9.0	n/e	n/e
Chloride	n/e	100-700	n/e
Sulfate	n/e	n/e	1000
Nitrate+Nitrite (as N)	n/e	n/e	100
Turbidity	n/e	n/e	n/e
Dissolved Oxygen*	6.5-9.5	n/e	n/e

† Guidelines presented in mg/L unless otherwise noted.

n/e not established

* Guideline for the lowest acceptable D.D. concentration for early (9.5 mg/L) and other (6.5 mg/L) life stages in cold water ecosystems (CCME 1999a)

Table 5.3.4 Canadian Water Quality Guidelines for Ammonia (total, mg/L) for the Protection of Aquatic Life

Temp (°C)	pH							
	6	6.5	7	7.5	8	8.5	9	9.5
0	231	73	23.1	7.32	2.33	0.749	0.25	0.0042
5	153	48.3	15.3	4.84	1.54	0.502	0.172	0.0034
10	102	32.4	10.3	3.26*	1.04*	0.343	0.121	0.0029
15	69.7	22	6.98	2.22*	0.715*	0.239	0.089	0.0026
20	48	15.2	4.82	1.54	0.499	0.171	0.067	0.0024
25	33.5	10.6	3.37	1.08	0.354	0.125	0.053	0.0022
30	23.7	7.5	2.39	0.767	0.256	0.094	0.043	0.0021

* pH range of 7.5-8 and water temperature range of 10-15°C is representation of summer conditions in watercourses crossed by the proposed TCH.

Objectives of the sulfide bearing rock drainage work were as follows:

- identify potential areas of Project interaction with sulfide bearing rock based on a review of available geologic mapping;
- identify potential areas of Project interaction with sulfide bearing rock based on an induced polarization field investigation;
- preferentially sample and analyze bedrock at visible outcroppings and existing rock cuts along the proposed TCH based on the results of the map review and the induced polarization investigation;
- delineate areas of low or high potential for sulfide bearing rock based on the test results;



- recommend further sampling / testing to be implemented during construction; and
- recommend general mitigative measures and disposal options with respect to sulfide bearing rock.

Prior to initiating a field sampling program, available geological mapping was reviewed to determine whether particular areas had a greater potential to have sulfide bearing bedrock based on lithology. In addition, the results from an induced polarization survey undertaken by NBDOT were reviewed in terms of any anomalous results. Anomalous results (areas of potential sulfide bearing rock) were overlain on a map with areas where road cuts are likely to exceed 3 m in depth. Based on the above information, a field sampling program was undertaken to collect samples from areas within representative geological units and in areas as close as possible to locations where deep grade cuts are proposed or in areas where anomalous results were obtained with the induced polarization survey. If possible, these samples were collected a minimum of 200 mm below the weathered zone so as to obtain an unoxidized/unweathered sample. Sampling locations are presented in Figures 3.2A-D (Appendix C).

In total 32 samples of bedrock were obtained between Perth-Andover and Woodstock. Most of the samples were obtained from rock cuts along the existing highway or secondary roads while some of the samples were obtained from outcrops located near roads. Table 5.3.5 summarizes all the samples collected and details the results of the laboratory testing performed. No attempt was made to collect samples along the actual proposed RoW, as rock outcrops were not expected. However, where existing roads crossed the proposed alignment or were located in close proximity, every effort was made to obtain samples. Even sampling distribution, within the Assessment Area, was achieved to the extent practical.

All samples collected for testing were submitted to the laboratory for analysis of total sulfur. If the total sulfur concentration equaled or exceeded 0.3% by weight, then the sample was considered potentially acid generating and was submitted for testing using the modified acid based accounting (ABA) method (also known as the modified Sobek Method) to determine sulfide sulfur concentration and neutralizing potential (NP). The testing method used is from the Acid Rock Prediction Manual (MEND, March 1991). Based on the results of the ABA testing, a sample is still considered to be potentially acid generating if the sulfide sulfur concentrations exceed or equal 0.3% and the neutralizing potential / acid producing potential (NP/AP) is less than or equals 3.0 (where NP and AP are measured in kg of CaCO_3 / tonne of rock).



Table 5.3.5 Sulfide Bearing Rock Sampling Locations

Sample No.†	Approximate Location	Total Sulfur (% by mass)	Sulfide Sulfur (% by mass) ¹	NP/AP Ratio ²
1	Connell Road Exit	0.144	---	---
2	Lockhart Mill Road	0.197	---	---
3	Route 2 – Harper Brook	0.120	---	---
4	Route 2 – Waterville	0.320	0.310	13.9
5	Waterville Dead Water	0.042	---	---
6	Jacksonville	0.019	---	---
7	Past Palmer Road	0.023	---	---
8	Wilmot	0.611	0.610	6.0
9	Dryer Road	0.047	---	---
10	Charleston Tower	0.082	---	---
11	Estey Road	0.190	---	---
12	St. Thomas	0.022	---	---
13	Upton	0.055	---	---
14	Florenceville	0.249	---	---
15	Sippelle Road	0.055	---	---
16	Back Greenfield Road	0.012	---	---
17	J. Clark Road	0.027	---	---
18	Summerfield	0.125	---	---
19	Wakem Corner	0.013	---	---
20	Big Presque Isle Stream	0.052	---	---
21	Route 2 – Past Summerfield Rd	0.042	---	---
22	Route 2 – Clearview	0.148	---	---
23	Route 2 – River de Chute	0.110	---	---
24	Route 2 – Scott Road	0.396	0.394	7.1
25	Route 2 – Hillandale	0.338	0.335	12.2
26	Route 2 – West Riverside Road	0.277	0.275	11.3
27	Route 2 – Perth-Andover	0.139	---	---
35	Route 2 – Wark Brook	0.218	---	---
36	Beaconsfield Road	0.067	---	---
37	Scott Road	0.568	0.566	5.0
38	River du Chute, Past Rte 560	0.263	0.263	15.6
39	B. Smith Road	0.025	---	---

1 If the total sulfur concentration equaled or exceeded 0.3% by weight, then the sample was considered potentially acid generating and was submitted for testing using the modified acid based accounting (ABA) method to determine the NP/AP ratio.

2 NP/AP ratio is the neutralizing potential/acid producing potential, where NP and AP are measured in kg of CaCO₃/tonne of rock.

† Sampling locations presented in Figure 3.2A-D



A group of samples with elevated sulfide sulfur levels were obtained between Perth-Andover and River de Chute. Five samples had sulfide sulfur concentrations between 0.26 and 0.57%, however, the neutralizing potential was sufficient to raise the NP/AP ratio adequately above the recommended level of 3.0. In addition, two isolated samples between Hartland and Woodstock also had elevated levels of sulfide sulfur with a correspondingly high neutralizing potential. Overall, no samples collected as part of this study tested positive for acid generating potential. However, the presence of a concentrated group of samples with elevated sulfide sulfur levels near the northern limits of the Project is cause for concern and additional sampling and testing during construction should be undertaken. The results of this testing program indicate a range of neutralizing potential within the areas where elevated sulfide sulfur concentrations were obtained. Therefore, isolated areas may contain lower levels that could result in NP/AP ratios below 3.0.

5.3.5 Environmental Effects Analysis

5.3.5.1 Project-VEC Interactions

Surface water supplies are sensitive to environmental effects resulting from development activities. As a result development in a watershed can pose potential environmental effects to water quality. Surface water resources are hydraulically linked to groundwater resources (Section 5.2) and fish and fish habitat (Section 5.4). Surface water quality can be directly affected by the volume and quality of groundwater flowing to the surface water; while conversely, surface water quality and quantity may affect groundwater quality and quantity. Construction activities may alter existing overland drainage patterns and result in the transport of suspended solids to the nearest stream or wetland.

The key environmental issues for surface water resources from a linear development include:

- interference with drainage,
- interference with the local flood regime; and
- degradation of the water quality of surface water resources.

Table 5.3.6 provides a summary of the potential environmental effects resulting from the Project-VEC interactions. The table is divided according to each of the Project phases assessed (construction, operation and maintenance), as well as for accidents, malfunctions and unplanned events. The discussion following the table provides an analysis of key Project-VEC interactions.



Table 5.3.6 Project Activity – Environmental Effects Interaction Matrix for Surface Water

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>SURFACE WATER</u>		
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	
	Change in Water Quantity	Change in Water Quality
Construction		
Site Preparation	✓	✓
Watercourse Crossing Structures	✓	✓
Roadbed Preparation	✓	✓
Surfacing and Finishing		✓
Ancillary Structures and Facilities	✓	✓
Operation		
Winter Safety		✓
Proposed TCH Presence	✓	✓
Maintenance		
Proposed TCH Maintenance		✓
Vegetation and Wildlife Management		✓
Accidents, Malfunctions and Unplanned Events		
Hazardous Material Spills		✓
Erosion and Sediment Control Failure		✓
Fire	✓	✓
Bridge or Culvert Washout		✓

5.3.5.1.1 Construction

The environmental effects associated with construction include increases in total suspended sediments, increased turbidity, change in hydrologic conditions (e.g., changes in catchment area, drainage pattern, runoff characteristics), change in pH due to the potential to expose sulfide bearing rock, and increased temperature due to change in surrounding land cover (e.g., change from forest cover to clearing). Recreational water quality is not likely to be affected as the principal concern would be introduction of sewage to streams used for recreational purposes. The project will not result in sewage discharge in an uncontrolled or untreated manner, hence there is no substantive interaction and this subject is not carried through the assessment.

The potential interference with the local drainage by the construction of the proposed new highway may consist of the blockage or alteration of existing drainage patterns or the creation of new drainage channels over previously undisturbed terrain.



Site Preparation

Erosion and sedimentation are possible in all phases and most activities of the Project. They are discussed here in Site Preparation because it is the first occurrence for this potential Project-VEC interaction. Erosion and sedimentation can occur anywhere and anytime soil is exposed. Potential characteristics of the proposed watercourses that may increase the risk of erosion and sedimentation include stream morphology and high discharge in the presence of erodible soils. The potential environmental effects of erosion and sedimentation on surface water is assessed in Section 5.4.5.1.1 of Fish and Fish Habitat.

Removing vegetation near riverbanks may increase bank erosion. Clearing and grubbing activities also have the potential to expose sulfide bearing rock. Drainage of sulfide bearing rock areas to watercourses can change the pH of surface waters. The ecology of the system begins to experience adverse change at pH levels below 6.0, with a reduction of diversity in plant and animal species.

Roadbed Preparation

Blasting

Blasting can have physical and chemical environmental effects on the Surface Water environment. Blasting can cause resuspension of sediments (Munday *et al.* 1986), bank failure and resultant sedimentation. Nitrogen-based explosives can reduce dissolved oxygen during nitrification and provide nutrients for aquatic plants. Nitrite promotes algal growth, which can lead to a deterioration of water quality. The potential environmental effects of blasting on surface water are assessed in Section 5.4.5.1.1 of Fish and Fish Habitat.

Excavation

Erosion and sedimentation can occur with this phase. The other primary potential environmental effect of excavation is exposing surface water to sulfide bearing bedrock and causing a pH reduction in Surface Water, as discussed above Site Preparation. Results of the preliminary sampling indicated no positive samples of sulfide bearing rock. However, the presence of a concentrated group of samples with elevated sulfide sulfur levels near the northern limits of the Project is cause for concern and will require follow up with additional sampling and testing during Construction.



Watercourse Crossing Structures

The proposed TCH will require the installation of culverts and bridges. During installation there is the potential for the discharge of sediment-laden runoff to the watercourse and for an increase in turbidity due to re-suspension of bottom sediments.

Surfacing and Finishing, and Ancillary Structures and Facilities

The handling of asphalt, concrete, hydrocarbon and hazardous materials during the construction phase and surfacing and finishing phase of the new TCH, and storage of these materials at ancillary facilities could potentially affect surface water resources. Most interactions would be considered the result of accidents, malfunctions and unplanned events.

The introduction of asphalt, and hydrocarbons to the aquatic environment can have deleterious environmental effects to water quality. The introduction of liquid concrete products or wash residues into watercourses can alter water chemistry (primarily pH). Few if any other hazardous materials besides petroleum hydrocarbons and concrete products are used in road construction.

Activities associated with the construction of ancillary facilities have the potential to expose sulfide bearing rock.

5.3.5.1.2 Operation

Winter Safety

Salting

During winter, salt is used by NBDOT on road surfaces to aid in melting snow, and to provide clear road conditions. Road salt can enter into watercourses, directly altering water chemistry. The potential environmental effects of chloride are presented in the Fish and Fish Habitat, Section 5.4.5.1.2

Sanding

The application of sand to provide increased traction during winter conditions may lead to increases in sedimentation of watercourses.



Proposed Trans-Canada Highway Presence

During the Project-related activities associated with proposed TCH presence, there is a potential for a change in water quantity. The contribution to runoff from the highway RoW will be more episodic, compared to the more gradual release of water from forested/vegetated areas, however, the potential for a substantive change in the quantity of surface water due to the highway construction is low because the surface area of the highway is relatively small compared to the area of the watersheds upgradient of the crossings of most of the watercourses. Water quality may also be affected by this interaction as runoff from pavement contains higher concentrations of suspended sediments.

The potential interference with the local flood regime by the construction of the proposed new highway would consist of the initiation or aggravation of local flooding (especially at watercourse crossings that: have large drainage basins, steep channel slopes, significant beaver activity, evidence of ice movement, an elevated ice jamming potential, and have substantial floodplains). In addition, improperly installed crossings can result in flooding and/or extensive erosion. Any improperly installed watercourse crossing structure would be considered an unplanned event, and is assessed as such.

5.3.5.1.3 Maintenance

Proposed TCH Maintenance

Maintenance of the proposed TCH may create dust and other sediment that may enter watercourses along the RoW. Maintenance of watercourse crossing structures may also introduce sediments from maintenance activities (*e.g.*, installing new liners) or may resuspend sediments when culvert blockages (*e.g.*, brush and leaves) are removed.

Vegetation and Wildlife Maintenance

Hydroseeding

Hydroseeding may result in small amounts of nutrients (*e.g.*, nitrate and phosphate) entering surface waters.

5.3.5.1.4 Accidents, Malfunctions and Unplanned Events

Accidents, malfunctions and unplanned events that may occur in association with the Project and have an adverse environmental effect on surface water resources:

- hazardous materials spills;
- erosion and sediment control failure;



- fire; and
- bridge or culvert washout.

Despite the use of proper safety facilities and procedures, it is possible to have a spill of hazardous materials during an accident, malfunction or unplanned event. A spill of hazardous materials has the potential to substantially affect the quality of the local surface water resources. Hazardous material spills could be the result of construction activities (e.g., equipment fuelling or faulty vehicle components), operation activities (e.g., hazardous material transport truck accident, or excessive salt application), or maintenance activities (e.g., equipment fuelling).

A potential exists of failure of erosion and sediment control structures due to precipitation events. Such a failure could result in the release of a large quantity of sediment-laden runoff to receiving watercourses.

Fire could remove riparian vegetation near watercourses. Also, burned forest land may be converted for agriculture. Fire may also temporarily elevate water temperature and increase sedimentation. Fire may be caused as a result of construction activities (e.g., hot equipment), operation activities (e.g., discarded cigarettes or hot exhaust systems in contact with roadside vegetation), and maintenance activities (e.g., hot equipment). Water required to fight the fire could affect surface water quantities. Potential environmental effects to surface water quality could result from the uncontrolled discharge of surface runoff (from fire fighting water) that may contain a wide range of contaminants from the fire.

Bridge or culvert washout may cause the loss or degradation of water quality. This could result from storms greater than accounted for in the structure design. Proper design and conservative forecasting should prevent this accident from occurring.

The potential environmental effects of bridge/culvert washout and/or ice/debris jams at the Project watercourse crossings would include local flooding. The potentially adverse environmental effects of this flooding consist of damage to private property, erosion or scarring of the watercourse banks, and washout of the highway. The environmental effects on surface water quality would consist of an increase in sediment loading in the watercourse as the channel bank and roadbed material would be added to the streamflow. A substantial structural failure could introduce enough debris in the watercourse to create a temporary blockage of water flow through the existing channel.



5.3.5.2 Environmental Effects Analysis and Mitigation

The criteria for characterizing the magnitude of environmental effects are described in the key for each phase of the Project. The criteria for characterizing the geographic extent of environmental effects are as follows:

- $< 1 \text{ km}^2$ (includes the surface water area within 100 m of a single watercourse crossing);
- $1\text{-}10 \text{ km}^2$ (includes the surface water area within a 500 m of a single watercourse crossing);
- $10\text{-}50 \text{ km}^2$ (includes the surface water area within 500 m downgradient of the RoW);
- $50\text{-}100 \text{ km}^2$ (includes the surface water area within 500 m either side of the RoW);
- $100\text{-}1,000 \text{ km}^2$ (includes the surface water area between the RoW and the Saint John River); and
- $>1,000 \text{ km}^2$ (includes all surface water area within the Upper Saint John River Valley).

5.3.5.2.1 Construction

During construction of the proposed TCH and associated roads and structures, several construction activities have the potential to affect surface water quality and quantity, as described in Table 5.3.7. These include any activities that involve disturbance to natural soils, and vegetation clearing that increases erosion and sedimentation, excavation of sulfide bearing bedrock, blasting, and storage and handling of hazardous materials. The sections following this table describe the mitigation strategies aimed at mitigating these potential environmental effects.



Table 5.3.7 Environmental Effects Assessment Matrix for Surface Water (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Construction</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in surface water quality (A) Change in surface water quantity (A)	- Follow EPP and EFG - Erosion/drainage control measures - Limit area of disturbance, especially within 30 m of watercourse - Minimize in stream work, work in the dry where feasible - Conduct specific sampling in sulfide rock risk areas - Follow NBDELG guidelines for sulfide rock disposal if applicable - Implement sulfide water handling and control measures where applicable - Follow beaver dam removal guidelines	1	4	2/1	R 2
Roadbed Preparation	Change in surface water quality (A) Change in surface water quantity (A)	- Follow EPP and EFG and site specific EPPs - Identify areas of acid rock drainage concern through sampling program - Obtain approval to blast from DFO - Follow DFO's blasting guidelines - Conduct specific sampling in sulfide rock risk areas - Follow NBDELG guidelines for sulfide rock disposal if applicable - Implement sulfide water handling and control measures where applicable	1	4	2/6	R 2
Surfacing and Finishing	Change in surface water quality (A)	- Follow EPP and EFG - Designated fuelling and storage area should be at least 100 m from watercourse	1	3	2/6	R 2
Watercourse Crossing Structures	Change in surface water quality (A) Change in surface water quantity (A)	- Follow EPP, EFG and site specific EPPs - Apply for Watercourse Alteration Permits, follow requirements - Follow NBDELG guidelines for watercourse alteration - Erosion control measures - Limit area of disturbance - Minimize in stream work, work in the dry where feasible	1	2	2/1	R 2



Table 5.3.7 Environmental Effects Assessment Matrix for Surface Water (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Construction</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Ancillary Structures and Facilities Construction	Change in surface water quality (A) Change in surface water quantity (A)	- Follow EPP and EFG - Erosion/drainage control measures - Designated fuelling and storage area should be at least 100 m from watercourse - Conduct specific sampling in sulfide rock risk areas - Follow NBDELG guidelines for sulfide rock disposal if applicable - Implement sulfide water handling and control measures where applicable	1	1-3	2/1	R 2
Key: Magnitude: 1 = <u>Low</u> : e.g., affecting the available quantity or quality of surface water resources such that these resources are either unavailable or unusable at levels that indiscernible from natural variation 2 = <u>Medium</u> : e.g., limiting the available quantity or quality of surface water resources such that these resources are occasionally rendered unsuitable to current users for periods of at least 2 weeks at a time 3 = <u>High</u> : e.g., limiting the available quantity or quality of surface water resources such that these resources are rendered unusable for current uses during the life of the Project, or for future generations beyond the cessation of construction activities Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N A = Not Applicable (A) = adverse (P) = positive						

Site Preparation

A summary of the hydrotechnical issues for each crossing is presented in Table 5.3.8. Identified in the table are the watercourses for which there is evidence of significant beaver activity, evidence of ice movement in the channel, the potential for ice/debris jams, the potential for sediment laden runoff to enter a watercourse during construction, and the potential for contaminated runoff (identified as cases where the roadway runoff is greater than 10% of the annual watercourse flow). The following subsections elaborate on the drainage, flooding and surface water quality concerns present during the site preparation phase.

Table 5.3.8 Summary of Hydrotechnical Issues for Watercourse Crossings

WC ID#	Watercourse Crossing Name*	Evidence of Beaver Activity	Evidence of Ice Movement	Ice Jam Potential	Sediment Runoff Potential	Roadway Runoff > 10% Annual Flow
1	Wark Brook				✓	
2	Tributary to Saint John River					✓
3	Tributary to Saint John River			✓	✓	
4	Tributary to Saint John River					
5	Tributary to Saint John River					✓
6	Tributary to Saint John River			✓	✓	✓
7	Plant Brook			✓		
8	Demerchant Brook			✓	✓	✓
9	Bryson Brook			✓	✓	✓
10	Tributary to Brown Brook			✓	✓	
11	Tributary to Brown Brook					✓
12	Tributary to Brown Brook			✓	✓	✓
13	Tributary to Brown Brook			✓	✓	
14	Graham Brook (Access Rd. D)			✓		✓
15	Graham Brook (outflow from Bishop Lake)	✓			✓	✓
15e	Graham Brook (existing lower road)				✓	
16	Graham Brook	✓			✓	
17	Tributary to River de Chute/McMullin Brook (Access Rd. F)					✓
18	River de Chute		✓	✓	✓	
19	Tributary to Upper Guisguet Brook					✓
20	Upper Guisguet Brook	✓		✓	✓	
21	Tributary to Upper Guisguet Brook					✓
22	Tributary to Lower Guisguet Brook				✓	✓
23	Tributary to Lower Guisguet Brook	✓			✓	✓
24	Lower Guisguet Brook / Tributary to Lower Guisguet Brook			✓		✓
25	Tributary to Lower Guisguet Brook	✓				
26	Tributary to Lower Guisguet Brook					✓
27	Tributary to Lower Guisguet Brook					✓
28	Tributary to Leith Lake Drainage					✓
29	Headwaters to Leith Lake Drainage					✓
30	Tributary 3 to Hunters Brook					✓
31	Tributary 2 to Hunters Brook					✓
32	Hunter Brook (Access Rd. J)				✓	
33	Big Presque Isle Stream		✓	✓	✓	





Table 5.3.8 Summary of Hydrotechnical Issues for Watercourse Crossings

WC ID#	Watercourse Crossing Name*	Evidence of Beaver Activity	Evidence of Ice Movement	Ice Jam Potential	Sediment Runoff Potential	Roadway Runoff > 10% Annual Flow
34	Tributary to Big Presque Isle Stream					✓
35	Tributary to Little Presque Isle Stream					✓
36	Little Presque Isle Stream		✓	✓	✓	
37	Little Presque Isle Stream					
38	Lanes Creek					✓
39	Tributary to Harper Brook					✓
40	Tributary to Harper Brook					✓
41	Tributary to Harper Brook					
42	Harper Brook			✓		
43	Tributary to the Meduxnekeag					✓

*refer to Figure 3.2 - A to D, Appendix C for stream locations



Drainage

It is expected that the majority of the watercourses along the proposed Project RoW are well defined with the existing local drainage concentrated through the channels. However, since the majority of the watercourses have small drainage areas, the additional drainage area from the proposed highway (e.g., road surface, median, ditches) becomes important (see areas and volumes of runoff in Table 5.3.9). In addition, the paved surface will prevent absorption causing runoff to move more quickly. This will increase the "flashy" nature of stream. The design of the structures and NBDOT watershed delineations will account for the additional drainage area and associated flows.

Table 5.3.9 Surface Runoff Estimates and Comparison

WC ID#	Watercourse Crossing Name*	Roadway Area (m ²)	Annual Roadway Runoff (m ³)	Watershed Area (km ²)	Annual Watershed Flow (m ³)	Ratio of Roadway Runoff to Watershed Flow (%)
1	Wark Brook	98,460	98,460	6.01	3,005,000	3.3
2	Tributary to Saint John River	48,840	48,840	0.87	435,000	11.2
3	Tributary to Saint John River	40,980	40,980	0.90	450,000	9.1
4	Tributary to Saint John River	55,440	55,440	0.91	455,000	12.2
5	Tributary to Saint John River	34,620	34,620	0.49	245,000	14.1
6	Tributary to Saint John River	38,700	38,700	0.91	455,000	8.5
7	Plant Brook	54,600	54,600	0.85	425,000	12.8
8	Demerchant Brook	65,820	65,820	0.88	440,000	15.0
9	Bryson Brook	22,500	22,500	0.57	285,000	7.9
10	Tributary to Brown Brook	45,900	45,900	0.87	435,000	10.6
11	Tributary to Brown Brook	43,140	43,140	0.34	170,000	25.4
12	Tributary to Brown Brook	19,800	19,800	0.78	390,000	5.1
13	Tributary to Brown Brook	53,400	53,400	0.37	185,000	28.9
14	Graham Brook (Access Rd. D)	20,070	20,070	0.81	405,000	5.0
15	Graham Brook (outflow from Bishop Lake)	39,660	39,660	0.40	200,000	19.8
16	Graham Brook	80,580	80,580	3.78	1,890,000	4.3
17	Tributary to River de Chute / McMullin Brook (Access Rd. F)	27,420	27,420	0.22	110,000	24.9
18	River de Chute	108,180	108,180	75.4	37,700,000	0.3
19	Tributary to Upper Guisiguit Brook	106,320	106,320	1.24	620,000	17.1
20	Upper Guisiguit Brook	47,400	47,400	37.1	18,550,000	0.3
21	Tributary to Upper Guisiguit Brook	26,700	26,700	0.08	40,000	66.8
22	Tributary to Lower Guisiguit Brook	100,320	100,320	1.91	955,000	10.5
23	Tributary to Lower Guisiguit Brook	96,000	96,000	0.60	300,000	32.0
24	Lower Guisiguit Brook / Tributary to Lower Guisiguit Brook	59,880	59,880	29.5	14,750,000	0.4



Table 5.3.9 Surface Runoff Estimates and Comparison

WC ID#	Watercourse Crossing Name*	Roadway Area (m ²)	Annual Roadway Runoff (m ³)	Watershed Area (km ²)	Annual Watershed Flow (m ³)	Ratio of Roadway Runoff to Watershed Flow (%)
25	Tributary to Lower Guisguir Brook	86,280	86,280	4.98	2,490,000	3.5
26	Tributary to Lower Guisguir Brook	73,620	73,620	1.06	530,000	13.9
27	Tributary to Lower Guisguir Brook	95,160	95,160	0.41	205,000	46.4
28	Tributary to Leith Lake Drainage	46,680	46,680	0.87	435,000	10.7
29	Headwaters to Leith Lake Drainage	75,180	75,180	0.41	205,000	36.7
30	Tributary 3 to Hunters Brook	183,540	183,540	1.18	590,000	31.1
31	Tributary 2 to Hunters Brook	102,180	102,180	2.58	1,290,000	7.9
32	Hunter Brook (Access Rd. J)	23,970	23,970	16.7	8,360,000	0.3
33	Big Presque Isle Stream	90,180	90,180	585	292,500,000	0.0
34	Tributary to Big Presque Isle Stream	190,500	190,500	1.81	905,000	21.0
35	Tributary to Little Presque Isle Stream	215,280	215,280	3.15	1,575,000	13.7
36	Little Presque Isle Stream	40,200	40,200	135	67,400,000	0.1
37	Little Presque Isle Stream	130,020	130,020	119	59,650,000	0.2
38	Lanes Creek	158,220	158,220	2.41	1,205,000	13.1
39	Tributary to Harper Brook	25,260	25,260	0.34	170,000	14.9
40	Tributary to Harper Brook	32,940	32,940	0.26	130,000	25.3
41	Tributary to Harper Brook	54,240	54,240	2.37	1,185,000	4.6
42	Harper Brook	103,380	103,380	2.70	1,350,000	7.7
43	Tributary to the Meduxnekeag	86,460	86,460	1.04	520,000	16.6

*refer to Figure 3.2A-D, Appendix C for stream locations

Where the removal of a beaver dams is required (e.g., to lower water levels), the beaver must be removed prior to the lowering of the dam by a licensed Nuisance Wildlife Control Officer in accordance with NBDNR *Beaver Dam Removal Guidelines*. The dams will be removed in accordance with the Watercourse Alteration Permit and Section 4.6 of the EFG. Typically the main constraints in removing a dam are that the dam breach cannot be wider than the average width of the channel below the dams, and any soils exposed as a result of the lowering of the water levels above the dam must be stabilized. Also, the dam will be removed in top down order to allow for a gradual release of water in the headpond.

Flooding

Three of the crossing locations (WC18 River de Chute, WC33 Big Presque Isle Stream and WC36 Little Presque Isle Stream) showed signs of active ice movement (ice scour, erosion, scarring, significant debris in channel) which could potentially be aggravated by construction of the new highway. There is



limited development in or near the floodplains of most watercourses that could be affected. However, several crossing locations were assessed as having the potential for ice or debris jams, which may endanger the stability of the roadway embankment. Based on the field inspections, the following watercourses were identified as being "flashy" (due to steep channel at crossing, large stable rock) and/or had steep banks at the crossing with no floodplain. These sites would have the potential for the initiation of an ice or debris jam especially with the additional flows from the proposed highway:

- WC03 Tributary to Saint John River;
- WC06 Tributary to Saint John River;
- WC07 Plant Brook;
- WC08 Demerchant Brook;
- WC09 Bryson Brook;
- WC11 Tributary to Brown Brook;
- WC12 Tributary to Brown Brook;
- WC13 Tributary to Brown Brook;
- WC18 River de Chute;
- WC20 Upper Guisiguit Brook;
- WC24 Lower Guisiguit Brook;
- WC33 Big Presque Isle Stream;
- WC36 Little Presque Isle Stream; and
- WC42 Harper Brook.

Based on the field inspections, the following five crossings were determined to have beaver activity, which could potentially initiate or aggravate local flooding:

- WC15 Graham Brook (outflow from Bishop Lake);
- WC15 Graham Brook (existing lower road);
- WC20 Upper Guisiguit Brook;
- WC22 Tributary to Lower Guisiguit Brook; and
- WC23 Tributary to Lower Guisiguit Brook.

Surface Water Quality

The potential for the entrance of sediment laden runoff is minimal in the majority of the watercourses as the general terrain outside of the floodplain and riparian zone is relatively flat. However, at approximately one-third of the watercourse crossings, steep banks could lead to sediment laden runoff entering the watercourses. These crossings are as follows:



- WC01 Wark Brook;
- WC03 Tributary to Saint John River;
- WC06 Tributary to Saint John River;
- WC08 Demerchant Brook;
- WC09 Bryson Brook;
- WC11 Tributary to Brown Brook;
- WC12 Tributary to Brown Brook;
- WC15 Graham Brook (Bishop Lake Outflow);
- WC16 Graham Brook;
- WC18 River de Chute;
- WC20 Upper Guisiguit Brook;
- WC22 Tributary to Lower Guisiguit Brook;
- WC32 Hunters Brook;
- WC33 Big Presque Isle Stream; and
- WC36 Little Presque Isle Stream.

Table 5.3.9 presents the ratio of surface water runoff to the annual streamflow for each crossing. The potential environmental effect of contaminated runoff from the driving surface of the new highway to the watercourses is believed to be of concern where the roadway runoff volume is greater than 10% of the annual streamflow volume. The crossings that satisfy these criteria are as follows:

- WC02 Tributary to Saint John River;
- WC04 Tributary to Saint John River;
- WC05 Tributary to Saint John River;
- WC07 Plant Brook;
- WC08 Demerchant Brook;
- WC10 Tributary to Brown Brook;
- WC11 Tributary to Brown Brook;
- WC13 Tributary to Brown Brook;
- WC15 Graham Brook (Bishop Lake Outflow);
- WC17 Tributary to River de Chute;
- WC19 Tributary to Upper Guisiguit Brook;
- WC21 Tributary to Upper Guisiguit Brook;
- WC22 Tributary to Lower Guisiguit Brook;
- WC23 Tributary to Lower Guisiguit Brook;
- WC26 Tributary to Lower Guisiguit Brook;
- WC27 Tributary to Lower Guisiguit Brook;
- WC28 Tributary to Leith Lake Drainage;



- WC29 Headwaters to Leith Lake Drainage;
- WC30 Tributary 3 to Hunters Brook;
- WC33 Tributary to Big Presque Isle Stream;
- WC35 Tributary to Little Presque Isle Stream;
- WC38 Lanes Creek;
- WC39 Tributary to Harper Brook;
- WC40 Tributary to Harper Brook; and
- WC43 Tributary to Meduxnekeag River.

Erosion and sedimentation could occur during all Project phases. Erosion systems will be in place to manage runoff from the construction areas. Erosion control measures are presented in Section 5.4.5.2.1 of the Fish and Fish Habitat VEC.

Erosion protection measures such as geotextiles and geomembranes will be used as necessary to minimize suspension and removal of soil particles by flowing water. Prior to the start of construction at each site, all erosion control structures such as silt fences, buffer strips, filter berms and sediment traps will be in place to trap any suspended soil particles from entering watercourses. Monitoring of erosion control structures will be conducted to ensure the structures remain in place and operate effectively throughout the construction period. Specifically, all structures will be inspected prior to and following any rainfall event, and at least daily during prolonged periods of rainfall. Erosion control measures will not be removed until the exposed areas have been stabilized by vegetation.

During construction, a wet weather shut down policy will be in place to avoid soil disturbance during runoff periods. In addition, a watercourse monitoring program will be developed in consultation with DFO, which will include total suspended solids and pH (where the potential for sulfide bearing rock drainage exists).

Clearing and grubbing will be minimized within 30 m of the watercourse. Enough vegetation must be allowed to grow along the bank of the watercourse to maintain the stability of the banks. Vegetation will also provide shade to prevent an excessive rise in water temperature. NBDOT will avoid long skids of timber on steep slopes adjacent to watercourses as well as avoid felling or skidding trees across a watercourse. Where possible, NBDOT will not use heavy machinery within 10 m of streambanks. Any trees that need to be cut within 10 m of a watercourse will be cut by hand or by machinery able to "reach-in" within those areas.

The environmental effect of removal of vegetation is reversible through natural succession and replanting of appropriate native vegetation.



Exposure of sulfide bearing rock is a possibility during site preparation activities. Mitigation activities to deal with sulfide bearing rock exposure are discussed in the following roadbed preparation subsection.

Sulfide Bearing Rock Drainage

Preliminary sampling indicated no positive samples of sulfide bearing rock. Prior to construction, NBDOT will use the results of the induced polarization investigation to complete the determination of the potential for a Project interaction with sulfide bearing rock by preferentially sampling those areas where anomalous induced polarization readings occurred.

Based on consideration of the potential environmental effects of the individual activities required for RoW preparation of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., NBDOT EPP, EFG, site specific EPPs and *Watercourse Alteration Technical Guidelines*), and the residual environmental effects significance ratings criteria, the environmental effects on surface water quality and quantity by these activities are considered not significant.

Roadbed Preparation

Blasting will be avoided where possible but in some instances it may be unavoidable. Should blasting be required during construction in or near a watercourse, authorization will be required from DFO for the use of explosives (Section 32 of the *Fisheries Act*). Blasting will be conducted in accordance with the EPP (Section 4.4) and EFG (Section 4.8.1) and *Guidelines for use of Explosives in Canadian Fisheries Waters* (Wright and Hopky 1998), and in full compliance with the requirements of DFO's authorization.

It is understood that the contract for the construction work would follow the normal public tendering process for NBDOT highway grading contracts. The NBDOT Standard Specifications (2003) would be followed as the contract requires and as such, this document outlines the general practices and standards that shall be applied to the work including but not limited to rock excavation (Item 108), placement of borrow (Item 121), and environmental requirements (Item 948).

It is common practice to discharge water accumulated within work areas on RoW or adjacent lands prior to proceeding with grading work. In sloping areas (vertical alignment), excavation waters or surface runoff from the RoW may need to be controlled during construction to minimize environmental effects on adjacent surface waters from erosion and sedimentation. Elevated suspended sediments, total dissolved solids and metal concentrations are common water quality issues associated with this activity, especially in seasonally wet periods.



Blasting within 50 m of a watercourse is considered part of watercourse alteration activities, and will follow the federal *Fisheries Act* guidelines for blasting.

Sulfide Bearing Rock

None of the samples collected in the preliminary sulfide bearing rock study tested positive. Sulfide bearing rock within the zone of influence of the Project is likely to have a high neutralizing potential. NBDOT intends to drill and collect bedrock samples along the proposed alignment prior to construction. Drilling at a regular interval will be undertaken within the areas where grade cuts are expected to exceed 3 m in depth. In addition, an increased sampling interval will be used for the sampling within the areas where the induced polarization investigation had identified anomalies. The samples will be tested for both sulfide sulfur content and NP/AP ratio. The magnitude of the risk can be defined by this testing and measures would only be employed where results would demonstrate a need.

Specialized disposal procedures for excavated sulfide bearing rock will be required to avoid long-term rock disposal effects, should sulfide bearing rock be exposed during Project construction activities. These procedures could include immediate disposal upon excavation, placement in covered contained holding areas for no longer than 30 days, and collection and disposal of associated low pH waters, until a final disposal site is selected. NBDELG guidance dealing with sulfide bearing materials will be followed in addition to mitigation measures outline in the EPP (Section 7.11). Final disposal would normally be undertaken in marine waters due to their neutralizing and reducing conditions. These regulations focus on disposal of sulfide bearing rock. For ocean dumping, an Ocean Dredging and Disposal Permit under the *CEPA* issued by Environment Canada would also be required. The dumping permit would apply to any rock placed in the ocean and might also apply to estuarine bodies, depending upon site location relative to the ocean.

Watercourse Crossing Structures

Preliminary details of the proposed watercourse crossing structures have been provided by NBDOT. These details (as presented in Table 5.3.10) include the type of structure (concrete pipe, concrete box, or open bottom structure), the number of structures, drainage areas and design flows. The suitability of these types of structures was reviewed based on observations made during the field inspections, as well as the crossing and watershed physiographic characteristics.

It should be noted that the drainage areas provided by NBDOT do not match those presented in other sections of this report. The drainage areas presented elsewhere in this report are based on existing (pre-construction) drainage patterns, while those presented below take into account changes in area due to the Project.



The seven structures proposed by NBDOT are in agreement with the seven crossings for which open bottom structures have been recommended. In these seven cases, the size of the crossing required precludes the installation of box or pipe culverts, which are typically the preferred crossing structures in terms of habitat destruction. In these cases open bottom structures will be used. Section 2.2.3 provides additional criteria for the selection of watercourse crossing structure type. The NBDOT proposed culverts meet or exceed the minimum hydraulic capacity requirements for all watercourse crossings based on the design flows presented below.

A review of the design flows and culvert sizes was performed using the Rational Equation and the pre-construction drainage areas presented in this report. Although the NBDOT design flows were calculated using a different methodology, the selected pipe sizes are the same with a larger diameter recommended for one crossing, WC27, Tributary to Lower Guisguait Brook. Using the review methodology, a culvert diameter of 1500 mm would be required. This method, however, does not account for the watercourse 27 culvert functioning as a wetland cross drain, and may over-predict the required pipe diameter, as attenuation of the peak flow due to wetland storage is not considered. Further review of the minimum culvert size for WC27, Tributary to Lower Guisguait Brook, is recommended in the final design.

Table 5.3.10 Summary of NBDOT Proposed Hydraulic Structures

WC ID#	Watercourse Crossing Name	Drainage Area (km ²)	Design Flow (m ³ /s)	Estimated Concrete Box or Pipe Size (mm)	Number	Estimated Length (m)
1	Wark Brook	6.01	n/d	n/d	n/d	n/d
2	Trib to Saint John River	0.87	3.24	1800	1	186.5
3	Trib to Saint John River	0.90	3.27	1800	1	192.5
4	Trib to Saint John River	0.91	3.59	1800	1	203.5
5	Trib to Saint John River	0.49	2.66	1500	2	58.5
6	Trib to Saint John River	0.91	3.48	1800	2	54.5
7	Plant Brook	0.85	3.63	1800	2	57.5
8	Demerchant Brook	0.88	3.84	1800	2	45.5
9	Bryson Brook	0.57	2.61	1500	2	45.5
10	Trib to Brown Brook	0.87	n/d	n/d	n/d	n/d
11	Trib to Brown Brook	0.34	n/d	n/d	n/d	n/d
12	Trib to Brown Brook	0.78	n/d	n/d	n/d	n/d
13	Trib to Brown Brook	0.37	n/d	n/d	n/d	n/d
14	Graham Brook (access rd)	0.81	n/d	n/d	n/d	n/d
15	Graham Brook (Bishops Lk)	0.40	0.65	1000	2	38.5
16	Graham Brook	3.78	8.23	2700	1	170.5
17	Trib to River de Chute	0.22	n/d	n/d	n/d	n/d
18	River de Chute	75.40	68.80	structure	2	370.0
19	Trib to Upper Guisguait Brook	1.24	n/d	n/d	n/d	n/d
20	Upper Guisguait Brook	37.10	42.30	Bridge	2	140.0



Table 5.3.10 Summary of NBDOT Proposed Hydraulic Structures

WC ID#	Watercourse Crossing Name	Drainage Area (km ²)	Design Flow (m ³ /s)	Estimated Concrete Box or Pipe Size (mm)	Number	Estimated Length (m)
21	Trib to Upper Guisguait Brook	0.08	n/d	n/d	n/d	n/d
22	Trib to Lower Guisguait Brook	1.91	4.31	2100	1	186.5
23	Trib to Lower Guisguait Brook	0.60	1.81	1500	1	194.5
24	Lower Guisguait Brook	29.50	40.40	structure	2	75.0
25	Trib to Lower Guisguait Brook	4.98	11.70	3600 x 2400	1	170.5
26	Trib to Lower Guisguait Brook	1.06	3.48	1800	2	57.5
27	Trib to Lower Guisguait Brook	0.41	1.03	1000	2	54.5
28	Tributary to Leith Lk	0.87	3.07	1800	2	57.5
29	Headwaters to Leith Lk	0.41	3.63	1800	2	46.5
30	Trib to Hunters Brook	1.18	n/d	n/d	n/d	n/d
31	Trib to Hunters Brook	2.58	8.73	2400	2	42.5
32	Hunters Brook	16.70	n/d	structure	n/d	n/d
33	Big Presque Isle Stream	585	400	structure	2	120.0
34	Trib to Big Presque Isle Stream	1.81	9.68	2700	2	74.5
35	Trib to Little Presque Isle Stream	3.15	10.10	2700	2	48.5
36	Little Presque Isle Stream	135	124	structure	1	100.0
37	Little Presque Isle Stream	119	112	structure	2	60.0
38	Lanes Creek	2.41	9.54	2700	2	38.5
39	Trib to Harper Brook	0.34	n/d	1000	2	36.5
40	Trib to Harper Brook	0.26	n/d	1000	2	36.5
41	Trib to Harper Brook	2.37	5.55	2100	2	32.5
42	Harper Brook	2.70	5.65	2100	2	38.5
43	Trib to the Meduxnekeag	1.04	4.91	2100	2	40.5

n/d = not determined

Generic diagrams of typical watercourse crossing structures including: pipe culvert; box culvert, arch; and bridge, are included in Section 2.2.3. Criteria used to determine which structure will be used at each site is also included in the discussion of alternatives in Section 2.2.3.

As part of the design process, an application for a Watercourse Alteration Permit will be made to NBDELG for each watercourse crossing and other construction activities within 30 m of a watercourse. Conditions associated with the permit will be met by NBDOT.

As part of the design process, a request for determination of navigability has been made to DFO (Canadian Coast Guard) for all watercourses crossed by the proposed TCH. The following were determined to navigable:



- WC18 - River de Chute;
- WC33 - Big Presque Isle;
- WC35 - Tributary to Little Presque Isle;
- WC36 - Little Presque Isle; and
- WC37 - Little Presque Isle.

Where watercourses are determined to be navigable by DFO, watercourse crossing structures will be in compliance with the Navigable Waters Permit as issued by DFO.

During construction, an on-site monitor (environmental inspector) will ensure that the installations are conducted according to the planning process, meet the Conditions of Approval as prescribed in the Watercourse Alteration Permit and do not introduce suspended sediments or contaminants to surface waters.

All culverts will be designed following the *Guidelines for the Protection of Fish and Fish Habitat - The Placement and Design of Large Culverts*, Fisheries and Oceans Canada, Maritimes Region (DFO 1999a) and the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b). Culverts will be installed following Section 5 of the EPP and Section 6 of the EFG. Bridges will be installed following Section 5 of the EPP and Section 7 of the EFG.

Surfacing and Finishing, and Ancillary Structures and Facilities Construction

Specific mitigative measures in regard to storage of hazardous materials are identified in Section 4.19 of the EPP and Section 5.0 of the EFG. Storage of hazardous materials will not occur within 100 m of a watercourse. Permanent storage areas for containers or drums will be clearly marked, have appropriate secondary containment, and be located on an impermeable floor that slopes to a safe collection area. Refuelling of equipment will not be undertaken within 30 m of a watercourse. Wastewater from washing equipment will not be released into a watercourse. Storage of all hazardous materials will comply with WHMIS requirements, and appropriate material safety data sheets will be located at the storage site. Spills or accidental release of hazardous materials are evaluated within the Accidents, Malfunctions and Unplanned Events phase.

Mitigation for Project interactions with sulfide bearing rock during ancillary structures and facilities construction activities will be mitigated as described for roadbed preparation activities.

Based on consideration of the potential environmental effects of the individual activities and physical works required for construction along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs, *Watercourse Alteration Technical Guidelines*, Design criteria for Fish Passage and New Brunswick Regulations concerning sulfide bearing materials),



and the residual environmental effects significance ratings criteria, the environmental effects of construction on surface water quality and quantity are considered as not significant.

5.3.5.2.2 Operation

The following provides an evaluation of key potential Project-VEC interactions for the operation phase of the Project as summarized in the environmental effects assessment matrix (Table 5.3.11). Operation of the proposed TCH will continue in perpetuity upon completion of the construction phase of the Project. The main issues in this phase of the Project related to surface water are proposed TCH presence (e.g., long term erosion, sedimentation and runoff), and winter safety (e.g., use of salt and sand for snow removal and providing traction). Further discussion, by Project phase follows the table.

Table 5.3.11 Environmental Effects Assessment Matrix for Surface Water (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in surface water quality (A)	- Develop long term salt management plan - Follow EPP and EFG	1	3	2/2	R	2
Proposed TCH Presence	Change in surface water quality (A) Change in surface water quantity (A)	- Proper design of cut and fills and ditching - Site specific EPPs - Regular inspection and maintenance of watercourse crossing structures - Watercourse Alteration Technical Guidelines	1	3-4	5/6	R	2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of surface water resources such that these resources are either unavailable or unusable at levels that indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of surface water resources such that these resources are occasionally rendered unsuitable to current users for periods of at least 2 weeks at a time 3 = High: e.g., limiting the available quantity or quality of surface water resources such that these resources are rendered unusable for current uses during the life of the Project, or for future generations beyond the cessation of construction activities Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							



Winter Safety

Environment Canada recently completed an assessment of road salt under *CEPA*. Recognizing that a total ban of road salt could potentially compromise human safety, the focus of road salt risk management is on implementation measures that optimize winter road maintenance practices so as to not jeopardize road safety while minimizing the potential environmental effects (Environment Canada 2001c). Therefore Environment Canada has categorized road salt as a Track 2 substance, requiring Life-Cycle Management. Management instruments to reduce the potential environmental effects of road salts are being developed through a national multi-stakeholder group (which involves representation from NBDOT) working in conjunction with Environment Canada. In accordance with Environment Canada's policy on road salt, all road agencies must develop a Salt Management Plan. NBDOT is committed to developing best salt management practices in a continued effort to reduce the environmental effects of road salt on the environment.

As per Environment Canada's Code of Practice for the Environmental Management of Road Salts, NBDOT is in the process of developing a salt management plan. The primary objective of the plan is to minimize the use of salt. The salt management plan will be grounded in the principles of safety, environmental protection, continual improvement, fiscal responsibility, efficient transport systems, accountability, measurable progress, agency-based communication, knowledgeable and skilled workforce.

Procedures outlined in the Transportation Association of Canada's Best Practices for Road Salt Management will be incorporated into the document. Specific measures of the salt management plan are not known at this time however the following elements will be incorporated into the plan:

- a commitment to achieve environmental protection without compromising road safety;
- methods to help deliver appropriate amounts of road salt in the right place at the right time;
- use of alternative methods in vulnerable areas such as groundwater recharge areas, small lakes and ponds, low flow rivers, salt sensitive vegetation and wetlands, species at risk habitat and agricultural areas;
- provisions to measure the effectiveness of road salt;
- increased monitoring of watercourses along dense highway networks; and
- a requirement that NBDOT and all developers follow the plan."

Section 6.2 of the EPP and Section 5.6 of the EFG identify salt application protection measures. Application rates identified in the Highway Maintenance Management System Field Manual (NBDOT 1992b) will be used to maximize the efficiency of salting and sanding and minimize the potential environmental effects.



Based on consideration of the potential environmental effects of the individual activities required for winter safety along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, and development of best salt management practices), and the residual environmental effects significance ratings criteria, the environmental effects on surface water quality and quantity by these Project-related activities are considered as not significant.

Proposed TCH Presence

The long-term operation of the proposed TCH may create conditions that allow for erosion and sedimentation. Stabilization during construction and permanent erosion control measures will mitigate long-term environmental effects of erosion and sedimentation. Appropriate erosion control measures for each watercourse bank will be specified in site specific environmental protection plans developed as part of the highway design. These will minimize the potential for stream bank destabilization and erosion. Residual environmental effects are expected to be not significant. There is a potential for runoff from the road surface to contain contaminants that may affect surface water quality.

Field studies presented in a series of resource documents for environmental assessments with traffic volumes and winter conditions similar to the Project were reviewed to predict the extent and magnitude of potential environmental effects of the Project on local surface water quality. The following five case studies are from a Federal Highway Administration document titled "Effects of Highway Runoff on Receiving Waters – Resource Document for Environmental Assessments (Dupuis *et al.* 1985).

- The University of Washington conducted research on the effects of highway stormwater runoff on aquatic ecosystems. Green algae, zooplankton and rainbow trout were evaluated to determine the toxic effects of stormwater highway runoff on Interstate 90 which has an average daily traffic of 7,700 vehicles, similar to the 5,500 on the existing TCH between Grand Falls and Aroostook. No apparent toxicity was observed in any of the samples.
- Similar studies along the Interstate 5, with an average daily traffic of 50,000 vehicles, showed toxicity in some of the rainbow trout samples due to high concentrations of soluble metals. Higher total suspended solids concentrations were also observed in these instances. It was hypothesized that high rates of respiration result in fish being stressed by the presence of suspended particulates. The stress leads to higher volumes of water passing over the gill and further reductions in pH in the region of the gills. Under these conditions, metals are more readily desorbed from particulates and can be taken up by the fish. Subsequent experimentation indicated that runoff passing through vegetated areas dramatically decreased total suspended solids levels and levels of extractable metals.
- During a winter snowmelt event at the Wisconsin Highway 15/Sugar Creek crossing, the stream exhibited only slightly elevated chloride concentrations at a highway influenced station during a



snow melt period (peak of 65 mg/L) as compared to the control station (42 mg/L during the melt), and background dry weather concentrations at all stations prior to the melt event (23 to 50 mg/L). Approximately 18.2 tons of salt had been applied to the 5.6 km long ROW tributary to the stream during the week prior to the melt event.

- In cases where increases were larger (up to 250 mg/L at a headwater tributary), during a snowmelt/rainfall event at I-85/Sevenmile Creek near Efland, North Carolina, considerably lower concentrations were observed downstream. As a result of dilution, downstream levels were 34 mg/L, as compared to 21 mg/L at the control station. Approximately 14.4 tons of salt were applied to the 7.7 km long ROW draining into the creek.
- Road salt can contribute to drift of stream benthos. Drift is a phenomenon in which organisms dislodge from the substrate and enter the water where they are swept with the current. Studies on the effect of deicing salt on drift of stream benthos indicate that drift in general, only occurs at concentrations of 1,000 mg Cl/L or more.

Highway runoff volume is equal to approximately 50% of the rainfall volume (per a given area) for a rural highway with a flush shoulder and non-paved ditches (Kobriger *et al.* 1981). The average total solids accumulation rate for this type of highway is approximately 5.5 kg/km of highway per day (summer conditions). This conservative value is based on 1981 technology (*e.g.*, emissions controls, gasoline quality), and it is likely that current and future accumulations are and would be less. The amount that would end up in highway runoff is a function of rainfall amount, intensity, duration, and pre-event conditions (*e.g.*, number of dry days preceding rain event). In general, rural 4-lane highway runoff has much less potential to affect watercourse water quality than does urban stormwater (Kobriger *et al.* 1981).

Potential mitigation to reduce the potential environmental effects of contaminated runoff from the proposed TCH on watercourses that have a ratio of roadway runoff to watershed flow of greater than 10% (Table 5.3.9) includes:

- increased employee awareness training prior to commencement of operation activities (*e.g.*, salt and sand application during winter) within these watersheds;
- install permanent sediment control structures (*i.e.*, check dams) in drainage ditches within these watersheds; and
- apply increased vigilance and inspection of permanent erosion and sediment control structures within these watersheds.

Culverts and bridges can become blocked with ice and/or debris. Culverts and bridges will be inspected, cleaned and repaired on a regular basis, to ensure adequate flow, and to maintain the integrity of the



structure. Watercourse and Wetland Alteration Permits will be applied for any activities at these crossings. The maintenance or construction activities will be conducted according to the requirements specified in the Watercourse and Wetland Alteration Permit. Section 5 of the EPP and Section 6 and 7 of the EFG protection measures will be implemented. Erosion control measures shall be installed as required, and removed material from the watercourse will be disposed of in such a way as to prevent material from re-entering the watercourse.

Based on consideration of the potential environmental effects of the individual activities and physical works associated with winter safety and the proposed TCH presence, the proposed mitigation (e.g., EPP, EFG, site specific EPPs, *Watercourse Alteration Technical Guidelines*, and regular inspection and maintenance of watercourse crossing structures), and the residual environmental effects significance ratings criteria, the environmental effects of operation on Surface Water quality are considered not significant.

5.3.5.2.3 Maintenance

The following provides an evaluation of key potential Project-VEC interactions for the maintenance phase of the Project as summarized in the environmental effects assessment matrix (Table 5.3.12). Routine highway maintenance that may potentially interact with surface water resources includes ditching, vegetation control and watercourse crossing structure repairs. Further discussion, by Project phase follows the table.

Table 5.3.12 Environmental Effects Assessment Matrix for Surface Water (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Maintenance</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Maintenance	Change in surface water quality (A)	- Follow EPP and EFG - Apply for Watercourse Alteration Permits, follow requirements - Implement necessary control measures - maintain buffer zone within 30 m of watercourse	1	3	5/6	R	2



Table 5.3.12 Environmental Effects Assessment Matrix for Surface Water (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Maintenance</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Vegetation and Wildlife Management	Change in surface water quality (A)	- Follow EPP and EFG - Apply for Watercourse Alteration Permits; follow requirements - maintain buffer zone within 30 m of watercourse	1	3	5-6	R	2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of surface water resources such that these resources are either unavailable or unusable at levels that indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of surface water resources such that these resources are occasionally rendered unsuitable to current users for periods of at least 2 weeks at a time 3 = High: e.g., limiting the available quantity or quality of surface water resources such that these resources are rendered unusable for current uses during the life of the Project, or for future generations beyond the cessation of construction activities Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = > 1,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = > 72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = > 200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Proposed TCH Maintenance

Ditching may be required to improve water flow or manage erosion or excessive vegetative growth. The primary issue of concern is the release of sediment into surface water bodies. Section 6.1.4 of the EPP and Section 4.4. of the EFG provides detailed protection measures to protect surface waters during ditching-related interactions. The end of ditching should not come within 30 m of a watercourse. Ditches should be directed into surrounding vegetation where possible, rather than entering directly into a natural watercourse. A Watercourse Alteration Permit will be applied for any activities within 30 m of a watercourse.

Vegetation and Wildlife Management

Vegetation control will be conducted by mechanical clearing during highway operation on the RoW (e.g., road shoulders and interchanges). As stated in Section 6.1.6. of the EPP, there will be no herbicides used for vegetation control. For vegetation control activities within 30 m of a watercourse,



when required, a Watercourse Alteration Permit will be obtained before initiation of activities. Slash shall not be allowed to enter any watercourse.

Based on consideration of the potential environmental effects of the individual activities associated with the vegetation and wildlife management along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs and *Watercourse Alteration Technical Guidelines*), and the residual environmental effects significance ratings criteria, the environmental effects of maintenance on surface water quality and quantity are considered not significant.

5.3.5.2.4 Accidents, Malfunctions and Unplanned Events

The following provides an evaluation of key potential Project-VEC interactions for accidents, malfunctions and unplanned events as summarized in the environmental effects assessment matrix (Table 5.3.13). The main issues related to surface water are hazardous materials spills, erosion and sediment control failure, fire and bridge/culvert washout and ice/debris jams. These accidents are possible during all Project phases. Further discussion of each accident type follows the table.

Table 5.3.13 Environmental Effects Assessment Matrix for Surface Water (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Material Spills	Change in surface water quality (A)	- Follow EPP and EFG procedures, and provincial and federal regulations should be followed for storage and handling of materials - Contingency plan - Employee training	1-2	3-5	1/1	R	2
Fire	Change in surface water quality (A) Change in surface water quantity (A)	- Follow EPP and EFG preventative measures - Contingency plan	1-2	4-5	1/1	R	2
Erosion and Sedimentation Control Failure	Change in surface water quality (A)	- Follow EPP and EFG - Regular inspections - Contingency plan	2	1-5	1/1	R	2



Table 5.3.13 Environmental Effects Assessment Matrix for Surface Water (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>SURFACE WATER</u> Phase: <u>Accidents, Malfunctions and Unplanned Events</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Bridge or Culvert Washout	Change in surface water quality (A)	- Design watercourse crossing to handle the 1 in 100 year peak discharge event - Conservative culvert and bridge design criteria - Regular inspection as part of maintenance program	1-2	1-2	1/1	R 2
Key: Magnitude: 1 = Low: e.g., affecting the available quantity or quality of surface water resources such that these resources are either unavailable or unusable at levels that indiscernible from natural variation 2 = Medium: e.g., limiting the available quantity or quality of surface water resources such that these resources are occasionally rendered unsuitable to current users for periods of at least 2 weeks at a time 3 = High: e.g., limiting the available quantity or quality of surface water resources such that these resources are rendered unusable for current uses during the life of the Project, or for future generations beyond the cessation of construction activities Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = > 1000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = > 72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = > 200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects N/A = Not Applicable (A) = adverse (P) = positive						

Hazardous Materials Spill

The potential environmental effects of hazardous material spills on aquatic life are described in Section 5.4.5.2.4 in Fish and Fish Habitat. It is not likely that a hazardous material spill would create a long-term Project-related exceedance of the CCME guidelines for the protection of aquatic life or recreation (CCME 1999). The likelihood of a hazardous material spill during construction will be minimized by following Section 4.19 of the EPP and Section 5 of the EFG. The likelihood of a hazardous material spill during Operation will be minimized through highway design standards, enforcement of speed limits, signage, and winter safety methods. In the event of a hazardous material spill, Section 5.7 of the EFG will be followed. Specifically, the spilled material will be controlled and contained, and NBDOT will assist with the clean up. Materials to facilitate a rapid containment and clean up of hazardous material spills will be available on site during construction in or near watercourses and wetlands. Section 5.2.5.2.4 describes the regulation of the transport of dangerous goods.



Site-specific EPPs will be developed for work near environmentally sensitive areas and these will address preparedness measures that are necessary to ensure effective emergency response in the event of spills is reflective of the level of sensitivity.

Based on consideration of an accident, malfunction, or unplanned event, involving the release of a hazardous material into Surface Water along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, Design Standards), and contingency plans (i.e., EFG) the environmental effects during construction and operation of hazardous material spills are considered unlikely and not significantly. However, because of the possibility (almost no chance of occurrence) of a substantial hazardous material spill of a toxic substance directly into a watercourse, the environmental effect of an accidental hazardous material spill on surface water quality is considered as potentially significant, but extremely unlikely.

Erosion and Sediment Control Failure

The potential environmental effects of an erosion and sediment control failure, and the proposed mitigation and contingencies are discussed in Section 5.4.5.2.4 of Fish and Fish Habitat.

Based on consideration of an accident, malfunction or unplanned event, involving an erosion and sediment control failure affecting surface water along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, and the environmental effects rating criteria, the potential environmental effects are considered as not significant.

Fire

The potential environmental effects a forest fire, and the proposed mitigation and contingencies are discussed in Section 5.4.5.2.4 of Fish and Fish Habitat.

Based on consideration of an accident, malfunction, or unplanned event, involving a forest fire contacting surface water along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, and the environmental effects rating criteria, the potential environmental effects are considered as not significant.

Bridge or Culvert Washout

There is a potential during high flood events for portions of the highway, or bridge or culvert installations to be washed out. This could temporarily degrade water quality due to increased sedimentation, or affect habitat quantity by deposition of debris material into the stream (concrete debris, bridge/culvert materials) that could affect stream flow. Factors influencing the magnitude,



duration and geographic extent of the environmental effect include amount and duration of flooding, type and size of washout, natural terrain surrounding the watercourse and location within the watershed. The extent of the environmental effects of such a road failure or washout on surface water is predicted to be low due to the small area of a watershed which is covered by the watercourse crossing. Reversibility potential is high due to the dynamic nature of stream high spring discharges and high spring bedload transportation.

Roads are most susceptible to washouts during the high flow period during and immediately following spring snow melt. Road design will focus on protection of the aquatic environment by incorporating buffer zones, drainage and erosion control features and very conservative culvert and bridge design criteria. Watercourse crossings (bridges and culverts) will be designed with a hydraulic capacity to handle at least the 1 in 100 year peak discharge event, and will follow the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b). Routine maintenance practices will include inspection of watercourse crossing structures and debris will be removed as appropriate.

Based on consideration of an accident, malfunction or unplanned event, involving a bridge or culvert washout affecting surface water along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, and the environmental effects rating criteria, the potential environmental effects are considered not significant.

5.3.5.3 Determination of Significance

Table 5.3.14 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and surface water resources, after taking into account any proposed mitigation. The table also considers the level of confidence of the study team in this determination and the likelihood of potential environmental effects. The residual environmental effects are considered not significant for all Project phases. Potential hazardous material spills for the Project are considered as significant for hazardous material spills, but unlikely.

Based on consideration of the Project related and cumulative environmental effects, it is concluded that the surface water resources in the vicinity of the Project have the capacity to meet the needs of the present and those of the future.



Table 5.3.14 Residual Environmental Effects Summary Matrix for Surface Water

Residual Environmental Effects Summary Matrix Valued Environmental Component: SURFACE WATER				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	3	3
Maintenance	NS	3	3	3
Accidents, Malfunctions and Unplanned Events	S	3	1	3
Project Overall	NS	3	3/1	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence: 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria				

5.3.6 Monitoring and Follow-up

The Project may result in residual environmental effects on surface water quality. In particular, total suspended solid (TSS) concentrations in watercourses may increase as a result of the mobilization of sediment from Project-related activities. An increase in TSS concentrations may elevate surface water temperature and increase the rate of sedimentation that may adversely alter fish habitat. In addition, the pH of surface water may be lowered (become more acidic) should water make contact with any sulfide bearing rock that may be exposed during Project-related activities.

The surface water monitoring program will consist of both compliance and effectiveness monitoring. During construction, compliance monitoring will ensure that all applicable environmental protection and permitting requirements for work within 30 m of a watercourse are followed, and that remedial action, if necessary, is successfully implemented. The surface water compliance monitoring will consist of the following core elements at all watercourses, as applicable:

- sampling of total suspended solids when precipitation events result in the visible overland flow of water;
- regular sampling of pH in watercourses where interaction with sulfide-bearing rock has been identified;
- inspection of all sediment and erosion control measures;
- inspection of hazardous materials storage areas (including possible sediment generating materials);



- inspection of watercourse crossing structures (including culverts) for verification of correct installation, and for subsequent signs of erosion or degradation (including beaver dams);
- development and maintenance of a log of erosion-prone areas;
- frequency of reporting to regulators; and
- exceedance thresholds and remedial actions.

The location and frequency of observations and the required sample size will be determined in consultation with NBDELG and DFO through their respective permitting and authorization processes.

Effectiveness monitoring for surface water is included in the description of effectiveness monitoring for Fish and Fish Habitat in Section 5.13.3.4.



5.4 Fish and Fish Habitat

5.4.1 Rationale for Selection as Valued Environmental Component

Fish and fish habitat was selected as a VEC because of the potential for interactions between Project activities and the freshwater biological environment; most importantly, the crossing by the proposed TCH of 43 watercourses and their related structures and activities (e.g., culvert and bridge installation).

In the context of the Fish and Fish Habitat VEC, the following definitions apply.

"Fish" is defined as per the *Fisheries Act* as fish and crustaceans and any parts of fish and crustaceans; and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish and crustaceans. Reference in the *Fisheries Act* to shellfish and marine animals is not included as the Project does not interact with the marine environment.

"Fish habitat" is defined as per the *Fisheries Act* as spawning, rearing, nursery, food supply, overwintering, migration corridors and any other area on which fish depend directly or indirectly in order to carry out their life processes.

In this section, the environmental effects of the Project activities on fish and fish habitat resulting from construction, operation, and maintenance as well as accidents, malfunctions and unplanned events is assessed.

5.4.2 Environmental Assessment Boundaries

5.4.2.1 Spatial and Temporal

The spatial boundaries (the "Assessment Area") for the assessment of the potential environmental effects of the Project on fish and fish habitat includes all watercourses that will be crossed by the proposed TCH, from the headwaters to the confluence with the Saint John River, and all water bodies (i.e., lakes and ponds) within 500 m of construction activities; where activities associated with site preparation, construction, operation, maintenance, and accidents, malfunctions and unplanned events of the Project could potentially result in environmental effects on Fish and Fish Habitat.

The Saint John River between Perth-Andover and Woodstock is included in the assessment as the proposed TCH alignment comes within the 500 m spatial boundary for water bodies (200 m) of the Saint John River between Scott Road and Fort Road (Figure 3.2A, Appendix C).



The temporal boundaries for the assessment of the potential environmental effects of the Project on Fish and Fish Habitat include the periods of construction, and subsequent operation of the Project in perpetuity.

5.4.2.2 Administrative and Technical

Fish and fish habitat are protected through federal and provincial legislation. Fish habitat is protected under the *Fisheries Act*, and by the Department of Fisheries and Oceans (DFO's) *Policy for the Management of Fish Habitat* (DFO 1986). This policy applies to all projects and activities in or near water, which could alter, disrupt or destroy fish habitat by chemical, physical or biological means. The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. The *Policy for the Management of Fish Habitat* is regulated by Sections 20, 21, 22, 30, 32, 35, 37, 40 and 43, of the *Fisheries Act*, that is administered by DFO. Crossings installed in watercourses that bear fish will be subject to a harmful alteration, disruption or destruction of fish habitat (HADD) authorization from DFO.

With respect to culvert and bridge installations, the *Fisheries Act* (Section 35) requires the protection of fish habitat in all watercourses that bear fish. This is administered in the province of New Brunswick by the *Watercourse Alteration Regulation* of the *Clean Water Act*. Applications will be made for Watercourse and Wetland Alteration Permits. This application process applies to all activities (construction of watercourses, clearing, repairing and maintenance) within 30 m of a watercourse. Watercourse crossings will be installed according to the *Watercourse Alteration Technical Guidelines* developed by NBDELG (2002b). In addition, all watercourse crossings of more than 1.2 metres in diameter and/or more than 25 metres in length, and/or with a slope above 0.5% will follow the *Guidelines for the Protection of Fish and Fish Habitat – The Placement and Design of Large Culverts* (DFO 1999a).

In addition, Coast Guard approval under the *Navigable Waters Protection Act* will be required for proposed crossings over navigable waters, and may influence the design and installation requirements for these crossing structures. Crossing structures for navigable watercourses will be designed in consultation with the NWPP.

A search was conducted for existing information on the watercourses within the zone of influence of the Project, through discussions with NBDNR (P. Seymour, pers. comm.), and DFO (R. Jones (Salmonid Research, Moncton), E. Arseneau (Fishery Officer, Saint-Léonard), K. Dickinson (Fishery Officer, Woodstock) and T. Currie (Habitat Assessment Biologist, Moncton), pers. comm.).



Communications with the academic research community included members of the Canadian Rivers Institute (Dr. R. Cunjak and Dr. A. Curry, pers. comm.) – based at the University of New Brunswick, Fredericton.

Communications with Aboriginal people are ongoing, and a traditional ecological knowledge (TEK) study is being conducted in support of the Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons VEC (Section 5.9). This TEK study is not yet complete, but may contain information regarding use of fishery resources by Aboriginal people within the zone of influence of the Project.

The spatial boundaries for fish and fish habitat includes the proposed alignment and the immediate habitat 500 m upstream to 500 m downstream of the RoW, where activities associated with site preparation and construction, operation, and accidents, malfunctions and unplanned events of the Project could potentially result in environmental effects on fish and fish habitat.

Fish and fish habitat assessments were carried out at each of the watercourses to be crossed for the proposed TCH between Perth-Andover and Woodstock in 2002 to provide a current and thorough examination of baseline conditions. The proposed TCH route was divided into three sections and the surveys were conducted by three teams (Dillon 2003; ACER 2003; JWEL 2003a). Where route alignment changes affected any watercourses, additional fish and fish habitat surveys were conducted as required in 2003.

5.4.3 Residual Environmental Effects Rating Criteria

A *significant residual environmental effect* on fish and fish habitat is one that alters fish habitat physically, chemically, or biologically, in quality or extent, in such a way as to cause an adverse change in the ecological function of that habitat, or an adverse change (caused by avoidance and/or mortality) in the distribution or abundance of a fish species or community that is dependent upon that habitat, such that natural recruitment would not re-establish the community to its original composition, density and extent in one generation; or would result in an unmitigated or non-compensated net loss of fish habitat as defined in the *Fisheries Act*.

5.4.4 Existing Conditions

The proposed TCH will be constructed west of the existing TCH through an area dominated by steep hills and valleys. A total of 43 watercourses are crossed by the 70 km length of the proposed TCH (Figure 3.2A-D, Appendix C). A number of other watercourses were identified in maps but were determined to be dry channels, or were not found, during the field surveys.



There are three lakes located within 500 m of the alignment - Leith Lake (Figure 3.2B, Appendix C), Reid Lake (Figure 3.2B, Appendix C), and Bishops Lake (Figure 3.2A, Appendix C). Bishops Lake is 100 m east and on a watercourse that is upstream of the proposed TCH, Reid Lake is approximately 450 m west on a watercourse not crossed by the proposed TCH, and Leith Lake is 100 m east and is downstream, but is not on a watercourse that will be directly affected by the Project. There are two lakes that are considered to be environmentally significant areas in the Guidelines (Appendix A). Ketch Lake is 1.7 km west of the proposed TCH RoW. Ketch Lake drains to Two Mile Brook, which is a tributary of Big Presque Isle Stream. Two Mile Brook is upgradient and upstream of any Project activities. Payson Lake is 3.5 km west of the proposed TCH, just north of the town of Woodstock. There are no anticipated interactions between the Project and these lakes, therefore the lakes are not characterized in this section and they are not carried forward in the environmental assessment.

5.4.4.1 Fish Species of Special Conservation Concern

Species at Risk Act

There are four freshwater fish species in New Brunswick with special conservation status as designated by the federal *Species At Risk Act* (SARA; as listed by COSEWIC 2003):

- the Inner Bay of Fundy Atlantic salmon (*Salmo salar*) as "Endangered";
- the Lake Utopia dwarf smelt (*Osmerus* sp.) "Threatened"; and
- the redbreast sunfish (*Lepomis auritus*) and shortnose sturgeon (*Acipenser brevirostrum*) as "Species of Special Concern".

None of these four fish species of special conservation concern have been recorded within the zone of influence of the Project previously, nor were they discovered during the baseline fish surveys conducted in support of this CSR (Dillon 2003; ACER 2003; JWEL 2003a).

New Brunswick Endangered Species Act

There are no species of freshwater fish listed under the *New Brunswick Endangered Species Act*.

NBDNR General Status of Wildlife in New Brunswick

NBDNR lists five freshwater fish species of special conservation concern:

- the Lake Utopia dwarf smelt as "At Risk";
- the anadromous Atlantic salmon and the striped bass as "May Be At Risk"; and
- the Arctic char and lake trout are listed as "Sensitive".



The Lake Utopia dwarf smelt, Arctic char and lake trout do not occur within the zone of influence of the Project.

The "May Be At Risk" designation is a high concern category that includes species that are of concern because of low numbers, population declines, or habitat pressures. Both of the listed species had a historical breeding population in the Saint John River watershed. The current status of these species is described below.

The striped bass had a historical breeding population in the Saint John River, but the spawning population is believed to be extirpated since 1979 (DFO 1999b). DFO stock status reports suggest that the extirpation was the result of loss of habitat from the construction of the Mactaquac Dam, and subsequent unnatural fluctuations in water velocity and volume. Striped bass occur periodically in the Saint John River below Mactaquac, but these are believed to be feeding migrants from waters located along the northeast United States coast (DFO 1999b; Allen Curry, pers. comm.). Striped bass were not known to use the Saint John River within the zone of influence of the Project.

Anadromous Atlantic salmon in the Saint John River and its tributaries are considered as part of the Outer Bay of Fundy Atlantic salmon stock. This stock is not currently a federally protected species, however their population numbers has been decreasing over the last 100 years and reached very low numbers in the last decade (DFO 2001; 2002). Historically, Atlantic salmon provided the primary recreational and commercial fishery in the Saint John River. Today, recreational and commercial fishing for Outer Bay of Fundy Atlantic salmon in rivers has been indefinitely banned pending a substantial improvement in adult salmon returns to native rivers, including the Saint John River (E. Arseneau, pers. comm.). Adult salmon numbers in the Saint John River have declined from the 1960's estimate of over 100,000 to the year 2002 count at the Mactaquac dam of less than 500. DFO attributes this loss primarily to the cumulative environmental effects of commercial fishing and hydroelectric power generation (DFO 2001; 2002). There is currently an intensive effort to re-establish Atlantic salmon stocks in the Saint John River. Despite current low numbers of mature fish, the Atlantic salmon is still considered to be of extreme value to recreational fishermen in the Upper Saint John River Valley (E. Arseneau, pers. comm.). Therefore, the anadromous Atlantic salmon was given special consideration in the assessment of environmental effects on fish and fish habitat.

5.4.4.2 Methodology

Discussions with NBDNRE (P. Seymour, pers. comm.), and DFO (R. Jones (Salmonid Research, Moncton), E. Arseneau (Fishery Officer, Saint-Léonard), and T. Currie (Habitat Assessment Biologist, Moncton), pers. comm.) revealed a distinct paucity of information for the watercourses. Discussions with Woodstock DFO personnel (K. Dickinson, Fishery Officer, pers. comm.) provided some insight



into the historical distribution of Atlantic salmon and gaspereau in the southern portion of the proposed TCH.

Discussions with members of the Canadian Rivers Institute provided no additional information for the watercourses in the Assessment Area (R. Cunjak, A. Curry, pers. comm.).

Table 5.4.1 links the watercourse reference used in those reports with the watercourse reference used in this CSR and provides information as to the reason for the proposed crossing (*i.e.*, proposed TCH, existing road improvement, new access road), if there was a route alignment change post-baseline survey in 2002 affecting that watercourse, and whether or not additional fish surveys were required in 2003.

Where hydrologic and water quality conditions permitted, qualitative electrofishing surveys were conducted at all watercourse crossings within the Project area during the summer of 2002. Where recreational species were caught (*i.e.*, trout, salmon or smallmouth bass), a quantitative electrofishing survey was conducted. Barrier nets were placed at the upstream and downstream ends of the selected site, enclosing an area of at least 100 m², where quantity of habitat was not limiting. Electrofishing passes were conducted until the number of fish caught declined consistently in three consecutive passes. Total standing stock was estimated using the electrofishing results with the Zippin method. All fish captured during the surveys were identified to species, measured to the nearest mm and released unharmed to the stream.

Habitat assessments were carried out at each of the watercourses to be crossed for the proposed TCH route between Perth-Andover and Woodstock in 2002. All habitat surveys were conducted as per NBDNRE guidelines, using the standard stream habitat forms (Hooper *et al.* 1995).

Additional surveys were conducted in the summer of 2003 due to changes in the alignment of the proposed TCH (as of 2002). These changes were made to avoid rare plants that were identified during the 2002 vegetation surveys. In addition to alignment changes, new access roads were proposed to connect land remnants to existing roads. Some of these access roads crossed watercourses outside the boundaries of the original surveys. There are also some proposed improvements for existing roads and associated watercourse crossing structures that intersect the proposed TCH. In all cases, stream habitat surveys were conducted in 2003. New fish surveys were conducted where:

- the 2003 alignment of the proposed TCH or access roads crossed a new watercourse (not included in 2002 survey); or
- the 2003 alignment of the proposed TCH or access road crossed a previously surveyed watercourse, but there was a barrier to fish passage (*e.g.*, waterfall, hanging culvert, beaver dam) between the previously surveyed location and the new crossing location.



Table 5.4.1 Watercourse Names and Fish Survey Requirements

WC ID#*	Watercourse Name / Description	Background Study ID#	2002 Baseline Report Author	New TCH (H) Existing (E) or Access (A)	Route Change Post 2002 Survey (Y/N)	Change in Route (m) or Distance from 2002 Survey (east / west)	2002 Fish Survey (Y/N)	2003 Fish Survey Completed (Y/N)	Watercourse Crossing Locations (Final †)	
									Easting (19T)	Northing (19T)
1	Wark Brook	PA14	JWEL	H	N	n/a	Y	N	597658.2	5176161
1a	Wark Brook (Access Rd. A)	n/a	n/a	A	N	n/a	N	N	597579	5176210
2	Tributary to Saint John River	PA13	JWEL	H	Y	31-w	Y	N	596956.7	5174719
2a	Tributary to Saint John River (Access Rd. A)	n/a	n/a	A	N	n/a	N	N	596784	5174778
3	Tributary to Saint John River	PA12	JWEL	H	Y	43-w	Y	N	596644.1	5173775
4	Tributary to Saint John River	PA11	JWEL	H	Y	76-w	Y	N	596453	5173017
4a	Tributary to Saint John River	n/a	n/a	A	N	75-W	N	N	n/a	n/a
5	Tributary to Saint John River	PA10	JWEL	H	Y	246-w	Y	Y	596383	5172142
5a	Tributary to Saint John River (Access Rd. B)	n/a	n/a	A	N	n/a	N	N	n/a	n/a
6	Tributary to Saint John River	PA9	JWEL	H	Y	104-w	Y	N	596660	5171450
6a	Tributary to Saint John River (Access Rd. B)	n/a	n/a	A	N	n/a	N	Y	n/a	n/a
7	Plant Brook	PA8	JWEL	H	Y	70-e	Y	N	597024	5170609
7a	Plant Brook (Access Rd. B)	n/a	n/a	A	N		N	N	n/a	n/a
8	Demerchant Brook	PA7	JWEL	H	Y	292-e	Y	Y	597252	5169096
9	Bryson Brook	PA6	JWEL	H	Y	363-e	Y	Y	597035	5168196
10	Tributary to Brown Brook	PA5	JWEL	H	Y	20-e	Y	N	596473.3	5167357
11	Tributary to Brown Brook	PA4C	JWEL	H	Y	51-w	Y	N	596258.4	5166695
12	Tributary to Brown Brook	PA4B	JWEL	H	Y	14-w	Y	N	596187.9	5166483
13	Tributary to Brown Brook	PA4A	JWEL	H	Y	14-e	Y	N	596114.2	5166189
14a	Graham Brook (Access Rd. D)	n/a	n/a	A	N	n/r	N	Y	595164.7	5165072
15	Graham Brook (outflow from Bishop Lake)	PA3	JWEL	H	N	n/a	Y	N	596376.9	5164846
15e	Graham Brook (existing rd. lower)	n/a	n/a	E	N	n/a	N	Y	596191.8	5164295
16	Graham Brook	PA2	JWEL	H	Y	58-e	Y	N	596636	5163864





Table 5.4.1 Watercourse Names and Fish Survey Requirements

WC ID#*	Watercourse Name / Description	Back-ground Study ID#	2002 Baseline Report Author	New TCH (H) Existing (E) or Access (A)	Route Change Post 2002 Survey (Y/N)	Change in Route (m) or Distance from 2002 Survey (east / west)	2002 Fish Survey (Y/N)	2003 Fish Survey Completed (Y/N)	Watercourse Crossing Locations (Final †)	
									Easting (19T)	Northing (19T)
17a	Tributary to River de Chute / McMullin Brook (Access Rd. F)	n/a	n/a	A	N	n/r	N	Y	595556	5161406
18	River de Chute	PA1	JWEL	H	Y	245-e	Y	Y	596356	5160738
19	Tributary to Upper Guisiguit Brook	WC1A	ACER	H	N	n/a	Y	N	596139.8	5159218
20	Upper Guisiguit Brook	WC1	ACER	H	Y	81-w	Y	N	595940.3	5157982
21	Tributary to Upper Guisiguit Brook	WC2	ACER	H	N	n/a	Y	N	596077.8	5157558
22	Tributary to Lower Guisiguit Brook	WC3	ACER	H	Y	66-w	Y	N	596858.9	5156202
23	Tributary to Lower Guisiguit Brook	WC3A	ACER	H	Y	172-w	Y	N	598455.6	5155151
24	Lower Guisiguit Brook / Tributary to Lower Guisiguit Brook (lower end of watercourse #35)	WC4/ WC4A	ACER	H	Y	46	Y	N	598822.5	5154873
25	Tributary to Lower Guisiguit Brook	WC5	ACER	H	Y	33-w	Y	N	599531.9	5153760
26	Tributary to Lower Guisiguit Brook (upstream of crossing #35)	WC6	ACER	H	N	n/a	Y	N	599793.9	5152132
27	Tributary to Lower Guisiguit Brook (upstream of crossing #36)	WC7	ACER	H	N	n/a	Y	N	600091	5151080
28	Tributary to Leith Lake Drainage	WC8	ACER	H	N	n/a	Y	N	601804.2	5148907
29	Headwaters to Leith Lake	WC9	ACER	H	N	n/a	Y	N	601919.4	5148270
30	Tributary 3 to Hunters Brook	WCD15	DILLON	H	N	n/a	Y	N	603615.5	5143900
31	Tributary 2 to Hunters Brook	WCD14	DILLON	H	N	n/a	Y	N	603940.4	5142501
32a	Hunter Brook (Access Rd. J)	n/a	n/a	A	N	n/r	N	Y	603362.9	5140790
33	Big Presque Isle Stream	WCD12	DILLON	H	Y	250-e	Y	N	604504	5139676



Table 5.4.1 Watercourse Names and Fish Survey Requirements

WC ID#*	Watercourse Name / Description	Background Study ID#	2002 Baseline Report Author	New TCH (H) Existing (E) or Access (A)	Route Change Post 2002 Survey (Y/N)	Change in Route (m) or Distance from 2002 Survey (east / west)	2002 Fish Survey (Y/N)	2003 Fish Survey Completed (Y/N)	Watercourse Crossing Locations (Final †)	
									Easting (19T)	Northing (19T)
34	Tributary to Big Presque Isle Stream	WCD11	DILLON	H	Y	n/r	Y	Y	605101.2	5137113
35	Tributary to Little Presque Isle Stream	WCD09	DILLON	H	N	n/a	Y	N	609111.5	5128743
36e	Little Presque Isle Stream	WCD08	DILLON	E	N	n/a	Y	N	610318.7	5126750
37	Little Presque Isle Stream	WCD07	DILLON	H	N	n/a	Y	N	608908.2	5125645
38	Lanes Creek	WCD06	DILLON	H	N	n/a	Y	N	608209.2	5121358
39†	Tributary to Harper Brook	WCD05	DILLON	H	N	n/a	Y	N	608123.7	5120229
40	Tributary to Harper Brook	WCD04	DILLON	H	N	n/a	Y	N	607894.8	5119908
41	Tributary to Harper Brook	WCD03	DILLON	H	N	n/a	Y	N	607789.7	5118862
42	Harper Brook	WCD02	DILLON	H	N	n/a	Y	N	607910.5	5118299
43	Tributary to the Meduxnekeag	WCD01	DILLON	H	N	n/a	Y	N	607372.3	5115000

n/a = not applicable; n/c = no change; n/r = not required

* a = access road, e = existing road; † these locations reflect the final alignment at westbound centreline; ‡ no defined channel found

Sources: JWEL 2003a; ACER 2003; Dillon 2003; JWEL 2003 survey (unpublished)



Three additional qualitative surveys and two additional quantitative surveys were carried out in 2003. Ten additional stream habitat surveys were carried out in 2003. The data from these surveys are reported in this report as applicable.

5.4.4.3 Fish Survey Results

A total of 16 fish species, representing 8 families, were recorded in watercourses during the 2002 and 2003 fish surveys. Two additional species, representing 2 families, were known to exist historically in these streams, making a total of 18 fish species, representing 10 families, that are known to use watercourses that will be crossed by the proposed TCH.

The most commonly represented family was the trout and salmon family (Salmonidae or "salmonids"). Salmonids present in the Project area during the fish surveys were brook trout (*Salvelinus fontinalis*), two introduced species, the rainbow trout (*Onchorynchus mykiss*) and brown trout (*Salmo trutta*), and Atlantic salmon.

The minnow family (Cyprinidae or "cyprinids") was represented by the northern redbelly dace (*Chrosomus eos*), blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), and the common shiner (*Notropis cornutus*).

The stickleback family (Gasterosteidae) was represented by the 3-spine stickleback (*Gasterosteus aculeatus*), the 4-spine stickleback (*Apeltes quadracus*), and the 9-spine stickleback (*Pungitius pungitius*).

All other families were represented by a single species. These include Cottidae [slimy sculpin (*Cottus cognatus*)]; Catostomidae [white sucker (*Catostomus commersoni*)]; Ictaluridae [brown bullhead (*Ictalurus nebulosis*)]; Centrarchidae [smallmouth bass (*Micropterus dolomieu*)]; and Percidae [yellow perch (*Perca flavescens*)].

The historical presence of Anguillidae [American eel (*Anguilla rostrata*)] and Clupeidae [alewife or gaspereau (*Alosa pseudoharengus*)] was determined in consultation with DFO (K. Dickerson, pers. comm.).

The distribution of fish species in watercourses that will be crossed by the proposed TCH, as determined during the 2002 and 2003 surveys and from information obtained from other sources, is presented in Table 5.4.2. The watercourses are listed in occurrence from north to south along the proposed TCH, and the fish species are grouped by family where applicable.



Table 5.4.2 Distribution Of Fish Species In Watercourses Crossed By The Proposed TCH

Sources: JWEL 2003a; ACER 2002; Dillon 2002;
JWEL 2003 survey (unpublished)

Key

	Presence
	Historical Presence
	Absence

* no fish found;

** all results from 2002 survey except as noted:

† 2003 fish survey; ‡ 2002 and 2003 survey

• DFO Personal Communication

Watercourse ID# and Name		Salmonidae	Cottidae: Slimy Sculpin	Gasterosteidae: Stickleback (3, 4, 9 spined)	Catostomidae: White Sucker	Cyprinidae	Other Species
		Brook Trout (bt); Atlantic Salmon (As); Rainbow Trout (rt); Brown Trout (bnt)				Northern Redbelly Dace (nrd); Blacknose Dace (bnd); Creek Chub (cc); Common Shiner (cs)	American Eel (Ae); Brown Bullhead (bb); Gaspereau (g); Smallmouth Bass (sb); Yellow Perch (yp)
Northern Section	1	Wark Brook	bt				
	2	Trib to Saint John River	bt				
	3	Trib to Saint John River	bt				
	4	Trib to Saint John River	bt				
	5**	Trib to Saint John River					
	6	Trib to Saint John River	bt				
	7	Plant Brook	bt				
	8	Demerchant Brook	bt				
	9*	Bryson Brook					
	10	Trib to Brown Brook	bt				
	11	Trib to Brown Brook	bt				
	12	Trib to Brown Brook	bt				
	13*	Trib to Brown Brook					
	14†	Graham Brook (access rd)	bt				
	15‡	Graham Brook (Bishops Lk)					
	16	Graham Brook	bt			cc	
	17*†	Trib to River de Chute					
	18	River de Chute	bt				
Middle Section	19	Trib to Upper Guisguait Brook	bt				
	20	Upper Guisguait Brook	As, bt	4		bnd	
	21	Trib to Upper Guisguait Brook					
	22	Trib to Lower Guisguait Brook	bt			bnd, cc	
	23	Trib to Lower Guisguait Brook					
	24	Lower Guisguait Brook	bt			bnd, cc	
	25	Trib to Lower Guisguait Brook	bt			bnd, cc	
	26	Trib to Lower Guisguait Brook				cc	
	27	Trib to Lower Guisguait Brook		9		bnd	
	28	Tributary to Leith Lk	bt				
	29	Headwaters to Leith Lk					
	30	Trib to Hunters Brook	bt			nrd, cc	
Southern Section	31	Trib to Hunters Brook	bt			cc	
	32†	Hunters Brook	As, bt			bnd, cc	
	33	Big Presque Isle Stream	As, rt, bnt*	3		bnd, cc, cs	Ae*, sb
	34	Trib to Big Presque Isle Stream	bt			cc	
	35	Trib to Little Presque Isle Stream	bt			nrd, bnd, cc	
	36	Little Presque Isle Stream	As*	bnt	3	bnd, cc	Ae*, g*
	37	Little Presque Isle Stream	As*	bt		bnd, cc, cs	Ae*, g*
	38	Lanes Creek	bt			nrd, cc	sb, bb, yp
	40*	Trib to Harper Brook					sb, bb
	41	Trib to Harper Brook	bt				
	42	Harper Brook	bt			nrd	
	43	Trib to Meduxnekeag				nrd	



In general, there are more fish species present in the southern portion of the proposed TCH RoW than in the northern. This is particularly evident in a comparison of similarly sized Little Presque Isle Stream (13 species) with River de Chute (2 species). The most likely reason for this observed difference is a combination of changing geomorphology and land use. The area and watersheds within the spatial boundaries of the Fish and Fish Habitat VEC can be divided into the following three sections.

The "**northern section**" between Perth-Andover (Wark Brook - WC1) and River de Chute (River de Chute - WC18) (Figure 3.2A, Appendix C) has the most severe topography, and is predominantly forested. The watercourses of this area are small, narrow, and colder. Brook trout dominate this area, and there are no warm water species with only one occurrence of a cyprinid species. Slimy sculpin are abundant in this area, particularly in River de Chute (WC18).

The "**middle section**" between River de Chute (Tributary to Upper Guisguet Brook - WC19) and Florenceville (Hunters Brook - WC32) (Figure 3.2B and C, Appendix C) has decreasing gradient, more cleared agricultural land, and is less forested. The watercourses are less free flowing, with more beaver ponds and more wetlands present. The species assemblage in this section is more diverse than the northern section, but not as diverse as the southern section, though still includes 3 cyprinid species, 2 stickleback species and brook trout and Atlantic salmon.

The "**southern section**" between Florenceville (Big Presque Isle Stream - WC33) and Woodstock (Tributary to Meduxnekeag - WC43) (Figure 3.2C and D, Appendix C) is mostly gently sloping hillsides, and predominantly cleared agricultural fields. The fish assemblages in this section are diverse and include warm/cool water species (*i.e.*, smallmouth bass, yellow perch, brown bullhead, and 4 cyprinid species), and cold water salmonids (*i.e.*, Atlantic salmon, brook trout, brown trout, and rainbow trout). Stickleback, slimy sculpin and gaspereau are also present. The two largest watersheds are located in this section, the Big Presque Isle Stream and the Little Presque Isle Stream. These larger watercourses contribute to the diversity in this section.

Information regarding fish species present in the Saint John River between Perth-Andover and Woodstock was obtained from the Canadian Rivers Institute (Allen Curry, pers. comm.). Specifically, 20 fish species from 11 families are known to use this section of the River. These fish include:

- Anguillidae [American eel];
- Catostomidae [white sucker (*Catostomus commersoni*)];
- Centrarchidae [pumpkinseed sunfish (*Lepomis gibbosus*), smallmouth bass];
- Clupeidae [alewife];
- Cyprinidae [common shiner, creek chub, fallfish (*Semotilus corporalis*), golden shiner (*Notemigonus crysoleucas*), lake chub northern redbelly dace];
- Cyprinodontidae [banded killifish (*Fundulus diaphanous*)];
- Esocidae [chain pickerel (*Esox niger*), muskellunge (*Esox masquinongy*)];



- Ictaluridae [brown bullhead];
- Percichthyidae [white perch (*Morone americana*)];
- Percidae [yellow perch]; and
- Salmonidae [Atlantic salmon, brook trout, rainbow trout].

The current fish community compositions, densities, and distributions within the spatial boundaries of the Fish and Fish Habitat VEC provides a benchmark for the evaluation of cumulative environmental effects as they reflect the sum of the environmental effects on the fish communities of all past and presently existing projects and activities in the assessment boundaries.

5.4.4.3.1 Recreational Fish Species

Recreational fish species, as determined by DFO, in the Upper Saint John River include all salmonids, smallmouth bass, American eel, and gaspereau (alewife) (E. Arseneau, pers. comm.).

Brook trout were the most common species in the fish survey and were determined to be present in 28 of 43 watercourses as shown in Table 5.4.2. Brook trout are well established throughout the Assessment Area, and in a large variety of habitats. In more than one case, brook trout were observed within a few metres of the origin of a stream, in water only a few centimetres deep.

Atlantic salmon parr were found in only 3 of the 43 watercourses (Upper Guisguet, Big Presque Isle and Hunters Brook), but were known to historically occur in at least 1 more (Little Presque Isle, K. Dickinson, pers. comm.). It is also likely that Atlantic salmon parr use River de Chute as rearing habitat (R. Jones, pers. comm.).

Rainbow trout were found on the Big Presque Isle Stream, but may occur in any watercourses capable of supporting trout (E. Arseneau, pers. comm.). Brown trout were found in Little Presque Isle Stream. In addition, there is a recreational fishery for brown trout on the Big Presque Isle Stream (K. Dickinson, pers. com.), though none were recorded from the fish survey. Rainbow and brown trout are not native to Atlantic Canada (Scott and Crossman 1973). They were introduced primarily through private stockings, and have self-sustaining stocks in some locations along the Upper Saint John River Valley (E. Arseneau, pers. comm.).

Smallmouth bass are considered important in terms of their recreational value to the province of New Brunswick, and in recent years, are the primary sport fish of Saint John River anglers. Smallmouth bass prefer warmer average temperature than do salmonids, and are not as adept at living in small stream environments. Smallmouth bass were recorded only in the Big and Little Presque Isle Streams at the time of the survey.



In addition to these present recreational species, there was historically a gaspereau dipnet fishery in the Little Presque Isle Stream (K. Dickinson, pers. com.).

5.4.4.4 Fish Habitat Survey Results

Table 5.4.3 contains the results of the 2002 and 2003 surveys for some of the key NBDNR parameters for habitat characterization, and also includes water quality parameters (*i.e.*, temperature, pH, and dissolved oxygen) as recorded in the field at the time of sampling. Additional water quality information is included in Surface Water (Section 5.3). These results are from stream reaches containing the proposed TCH RoW.

In general, the watersheds (drainage area) of these watercourses are small ($< 10 \text{ km}^2$), with the exception of WC18, River de Chute (69.9 km^2); WC33, Big Presque Isle Stream (600 km^2); and WC36 and WC37, Little Presque Isle Stream (110 km^2). As expected, these large watercourses contained the largest standing stocks of fish. Big and Little Presque Isle Streams also exhibited the greatest diversity of species, 10 and 12 respectively. The diversity at River de Chute may be limited by low water temperature and high flow. Of the 43 watercourses only these 3 have wet widths greater than 5 m, those being River de Chute (5.5 m), Big Presque Isle (44.3 m) and Little Presque Isle (14.7).

The summer water temperature in all streams was within the preferred range ($< 20^\circ\text{C}$) for brook trout (Scott and Crossman 1973) except WC15 (Graham Brook at Bishops Lake) which was a beaver pond. Likewise, the dissolved oxygen levels were also at acceptable levels for salmonids, except for WC26 and WC27 (Trib to Lower Guisguet Brook) which are beaver ponds and WC29 (Headwaters to Leith Lake) which is classified as deadwater.

The substrate in most streams was excellent for salmonid nursery and rearing habitat. Many streams also contained possible salmonid spawning habitat (cool, clear water dominated by gravel with low embeddedness).



Table 5.4.3 Summary of Key Fish Habitat Parameters

Water-course	Drainage Area (km ²)	Wet Width (m)	Channel Width (m)	Depth (cm)	Average Velocity (m/s)	Water Temp. (°C)	pH (units)	DO** (mg/L)	Substrate (%)						
									Bedrock	Boulder	Rock	Rubble	Gravel	Sand	Fines
1	6.01	1.4	2.2	10	0.04	15.7	7.2	8.0	0	15	15	30	15	5	5
2	0.87	1.0	1.7	6	0.08	14.8	7.1	8.1	0	10	20	25	20	15	10
3	0.90	0.8	1.6	5	0.10	16.8	7.3	8.5	0	5	10	20	45	20	10
4	0.91	0.8	2.1	6	0.2	17.0	7.9	9.4	0	0	5	20	50	15	10
5†	0.49	1.0	2.5	4	0.09	15.0	7.4	8.3	0	5	10	10	25	30	20
6	0.91	1.1	2.6	9	0.17	13.8	7.4	9.2	0	5	25	30	25	10	5
6a†	0.91	1.2	2.0	7	n/d	16.0	7.4	8.0	10	15	10	20	25	10	10
7	0.85	1.2	2.8	8	0.25	11.3	7.4	10.4	0	10	25	25	30	5	5
8†	0.88	1.1	1.9	5	0.25†	14.0	7.3	7.5	15	15	15	15	35	5	5
9†	0.57	0.8	1.5	6	0.20†	15.0	8.1	7.8	5	5	10	30	30	10	10
10	0.87	1.1	1.2	7	0.06	11.4	7.6	9.7	0	0	5	25	40	20	10
11	0.34	1.0	1.2	4	0.10	10.4	7.7	10.1	0	0	0	15	60	20	5
12	0.78	1.4	2.1	5	0.08	11.9	7.0	7.5	0	0	10	20	50	15	5
13 -	0.37	1.0	1.0	4	0.17	11.3	7.2	9.6	5	5	20	20	15	25	10
14a†	0.81	1.0	1.5	30	0.22	13.0	7.6	6.9	0	10	5	10	30	15	30
15	0.40	2.0	20.0	40	0	16.6	7.4	6.1	0	0	0	0	0	30	70
15e†	0.40	5.0	n/d	15	n/d	21.0	8.1	6.4	0	0	0	0	5	15	80
16	3.78	1.1	2.6	10	0.18	12.8	8.0	9.2	0	0	0	0	70	30	0
17a†	0.22	0.5	1.5	3	0.16	10.0	7.8	6.5	0	0	5	10	75	5	5
18†	75.4	5.5	9.0	25	0.50†	14.0	8.0	7.8	5	5	50	15	15	5	5
19	1.24	0.8	1.3	10	n/d	10.9	8.4	10.0	0	0	0	0	0	20	80
20	37.1	4.0	4.5	20	n/d	13.0	7.4	9.6	0	0	25	35	22	18	0
21	0.08	0.2	7.0	5	n/d	12.0	7.2	10.0	0	0	0	0	0	0	0
22	1.91	0.8	3.5	55	n/d	15.0	7.6	10.8	0	0	0	0	0	40	60
23	0.60	dry	4.0	dry	dry	dry	dry	dry	0	0	15	25	25	35	0
24	29.5	2.5	3.5	20	n/d	13.0	7.6	9.6	0	0	20	20	20	20	20
25	4.98	1.8	3.0	25	n/d	13.0	7.4	8.2	0	0	0	0	0	70	30
26	1.06	0.6	1.0	15	n/d	13.0	7.2	4.4	0	0	0	10	0	20	70
27	0.41	1.3	1.5	25	n/d	11.0	7.2	3.4	0	0	0	0	0	0	100
28	0.87	0.6	1.0	7	n/d	12.0	8.3	6.7†	0	0	15	10	25	35	15
29	0.41	1.3	n/d	25	n/d	13.0	5.8	3.4	0	0	0	0	0	0	100
30	1.18	1	1.1	6	n/a	9.0	7.9	n/c	0	0	0	0	0	0	100
31	2.58	1.4	2.8	4	n/a	14.0	7.9	n/c	0	0	10	20	60	5	0





Table 5.4.3 Summary of Key Fish Habitat Parameters

Water-course	Drainage Area (km ²)	Wet Width (m)	Channel Width (m)	Depth (cm)	Average Velocity (m/s)	Water Temp. (°C)	pH (units)	DO** (mg/L)	Substrate (%)						
									Bedrock	Boulder	Rock	Rubble	Gravel	Sand	Fines
32a†	16.7	4.5	5.5	25	0.06	18.0	8.1	8.4	0	0	5	10	35	30	20
33	585	44.3	47.1	20	2.11	15.0	8.1	n/c	0	5	10	50	35	0	0
34	1.81	1.7	1.9	15	n/d	11.0	n/c	n/c	0	0	0	0	0	60	40
35	3.15	n/d	2.5	>100	n/d	18.0	7.8	n/c	0	0	0	0	0	0	100
36	135	11.3	16.1	17	0.397	17.0	7.7	n/c	0	5	20	60	10	5	0
37	119	14.7	15.0	50	n/d	17.0	7.9	n/c	0	0	0	5	25	30	40
38	2.41	1.3	2.5	14	n/d	16.0	7.5	n/c	0	0	0	5	15	40	40
39^	0.34	n/a	n/a	n/a	n/d	n/c	n/c	n/c	n/a	n/a	n/a	n/a	n/a	n/a	n/a
40	0.26	dry	n/c	dry	dry	dry	dry	dry	n/a	n/a	n/a	n/a	n/a	n/a	n/a
41	2.37	1.4	2.4	3	n/d	16.0	8.0	n/c	0	0	0	40	40*	10	10
42	2.70	3.1	3.2	19	n/d	12.0	8.0	n/c	5	0	0	70	10	5	0
43^^	1.04	n/c	n/c	n/c	n/d	n/c	n/c	n/c	n/a	n/a	n/a	n/a	n/a	n/a	n/a

* all results from 2002 survey except as noted; ** Dissolved oxygen; n/a = not available/applicable; n/d = not determined; n/c = not collected

† 2002 survey; ‡ 2003 survey; ^ watercourse not found; ^^ NBDNRE forms not used because watercourse was a wetland

Sources: JWEL 2003a, ACER 2003; Dillon 2003; JWEL 2003 survey (unpublished)

* all results from 2002 survey except as noted; ** Dissolved oxygen; n/a = not available/applicable; n/d = not determined; n/c = not collected

† 2002 survey; ‡ 2003 survey; ^ watercourse not found; ^^ NBDNRE forms not used because watercourse was a wetland

Sources: JWEL 2003a; ACER 2003; Dillon 2003; JWEL 2003 survey (unpublished)



5.4.5 Environmental Effects Analysis

5.4.5.1 Project-VEC Interactions

Table 5.4.4 provides a summary of the potential Project-VEC interactions and the potential environmental effects associated with these interactions. The table is divided according to each of the Project phases assessed (construction, operation and maintenance), as well as for accidents, malfunctions and unplanned events. The discussion following the table provides an analysis of key project-VEC interactions, by Project phase.

Table 5.4.4 Project Activity – Environmental Effects Interaction Matrix for Fish and Fish Habitat

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>FISH AND FISH HABITAT</u>			
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects		
	Change in Habitat Quantity	Change in Habitat Quality	Direct Mortality
Construction			
Site Preparation		✓	
Roadbed Preparation		✓	✓
Watercourse Crossing Structures	✓	✓	✓
Surfacing and Finishing		✓	
Ancillary Structures and Facilities		✓	
Operation			
Winter Safety		✓	
Proposed TCH Presence	✓	✓	
Maintenance			
Proposed TCH Maintenance		✓	
Vegetation and Wildlife Management		✓	
Accidents, Malfunctions and Unplanned Events			
Hazardous Material Spills		✓	✓
Erosion and Sediment Control Failure		✓	✓
Bridge or Culvert Washout		✓	✓
Fire		✓	✓

5.4.5.1.1 Construction

There are several Project-related construction activities that could affect Fish and Fish Habitat within the Assessment Area. The most substantive and likely interaction is the loss, or change, of fish habitat as a result of the installation of watercourse crossing structures. In particular, the direct removal of fish habitat from installation of culverts with a closed bottom and from stream diversions necessary to link



the structure with the existing stream. Direct mortality may occur during watercourse crossing installations.

The other potential environmental effects that may occur during all construction phases (including watercourse crossings and bridge construction) include increases in total suspended sediments, increased turbidity, change in hydrologic conditions, change in pH, and increased temperature due to change in surrounding land cover (e.g., change from forest cover to clearing).

The Project is not anticipated to interact with the three lakes or the Saint John River, in terms of increased sedimentation during construction. However, there is the potential for some indirect environmental effects (i.e., noise from construction activities) that may cause temporary avoidance of fish habitat.

Site Preparation

Clearing and Grubbing

Riparian vegetation will be cleared for the highway RoW. Removing vegetation near riverbanks removes shaded habitat and may increase bank erosion. Fish are sensitive to changes in water temperature. Shaded areas provide cooler temperatures during periods of warm, sunny weather. Any reduction in available spawning or rearing habitat or barriers to traditional spawning migration routes could undermine the reproductive potential of the local stock.

Sedimentation (increased sediment load in stream water and deposition in downstream sediments) is perhaps the most common environmental effect of construction activities on fish and fish habitat. Suspended sediment also occurs naturally in watercourses, occasionally at high concentrations. The environmental effects of sediment are well studied and understood (Anderson *et al.* 1996). Anderson, *et al.* (1996) and Trow Consulting Engineers Ltd. (1996) summarized the potential environmental effects of sedimentation and siltation on fish habitat as follows:

- degradation of water quality (i.e., oxygen levels, light penetration, water temperature, water chemistry such as organics and metals) leading to changes in primary production and food availability;
- changes in stream morphology and stream bed porosity leading to degradation of spawning substrates, holding pools, instream cover and overwintering habitat;
- reducing the diversity and abundance of bottom dwelling fish food organisms; and
- the destruction of aquatic vegetation that are buried by sediments.



The potential direct environmental effects on fish are a function of the concentration duration of the exposure, sensitivity of the life stage, as well as the hardness, size and angularity of the suspended particles. They include:

- first-level behavioural responses, usually temporary and not resulting in a change in health;
- minor physiological influences where the fish may avoid the exposure but there may be environmental effects to health due to exposure or reduction in food supply;
- physiological changes due to long term exposure affecting life stages or feeding; and
- environmental effects on eggs and larvae which cannot avoid areas of exposure where larvae are most sensitive, eggs are marginally more tolerant.

Erosion and sedimentation could be associated with all phases and most activities of the Project and are discussed in Site Preparation because it is the first occurrence for this potential Project-VEC interaction. Erosion and sedimentation can occur anywhere and any time soil is exposed. Potential characteristics of the proposed watercourses that may increase the risk of erosion and sedimentation include stream morphology, high discharge, and the presence of erodible soils.

There are no unmitigated planned Project activities that should release substantial amounts of sediment to water or resuspend sediment or cause erosion. However, small increases of sediment in watercourses near construction sites are often unavoidable. Any substantive amount of sedimentation or erosion would be the result of accidents, malfunctions, or unplanned events.

Roadbed Preparation

Blasting

Blasting can have physical and chemical environmental effects on the aquatic environment. Shock waves and vibrations from blasting can damage fish swim bladders and rupture internal organs, and may kill or damage fish eggs or alevins (DFO 1995a). Blasting can cause resuspension of sediments (Munday *et al.* 1986), bank failure and resultant sedimentation and habitat avoidance. Nitrogen-based explosives can affect aquatic life through direct toxicity of the compounds, reducing dissolved oxygen during nitrification and providing nutrients for aquatic plants. Nitrite is highly toxic to fish and can reduce the oxygen carrying capacity of blood, ammonia can cause gill damage, and promote algal growth. Pommen (1983) provides detailed information on the potential chemical environmental effects of blasting.

Blasting may also result in the release of sediment to watercourses through the settling of dust and/or rock slides.



Excavation

The primary potential environmental effect of excavation is exposure of surface water to sulfide bearing bedrock and causing a pH reduction in watercourses to levels that are harmful to fish. When fish are exposed to low pH waters, the fish body fluids will lose sodium and chloride ions and plasma osmotic pressure decreases. This creates physiological stress in the fish, which can eventually cause death. Different fish species have different pH tolerances, with salmonids being quite sensitive. The ecology of the aquatic system starts to change at pH levels of 5.0 to 6.0, with a reduction of diversity and plant and animal species; pH values of 4.5 to 5.0 are harmful to salmonid eggs and fry, while pH values less than 4.0 are lethal to all salmonids. Excavation may also potentially increase sedimentation through the settling of dust.

The environmental effects of surface water exposure to sulfide bearing rock are assessed in Surface Water, Section 5.3.

Watercourse Crossing Structures

The proposed TCH will require the installation of culverts and bridges. The installation of closed bottom culverts (*e.g.*, pipes) results in the loss of fish habitat. Likewise, the installation of in-water bridge piers results in a loss of fish habitat. Direct mortality of fish may result from installation activities. Barriers to upstream movement could be created if culverts are installed with a greater than 0.5% slope, if the downstream end of the culvert is "hanging", if the culvert channelizes flow that creates increased flow velocity, if the culvert is too long, or if there is inadequate water depth caused by oversized culverts (NBDELG 2002b).

Surfacing and Finishing, and Ancillary Structures and Facilities

The handling of asphalt, concrete, hydrocarbon and hazardous materials during the construction phase and surfacing and finishing phase of the new TCH, and storage of these materials at ancillary facilities could potentially affect fish and fish habitat. Interactions other than minor chronic release (*e.g.*, minor drips from machinery) would most likely occur as the result of accidents, malfunctions and unplanned events.

The introduction of asphalt, and hydrocarbons to the aquatic environment can have harmful effects to fish and fish habitat (*e.g.*, plant life). The introduction of liquid concrete products or wash residues into watercourses could destroy fish and aquatic plants due to sedimentation and changes in water chemistry (primarily pH).



5.4.5.1.2 Operation

Winter Safety

Salting

During winter, salt is used by NBDOT on road surfaces to aid in melting snow, and to provide improved road conditions. Road salt can enter the environment (surface water, groundwater and soil) through storage and application of these salts. The highest concentrations are usually associated with winter and spring thaws. According to Environment Canada (2001c) "aquatic effects of chloride on aquatic organisms are usually observed at relatively elevated concentrations (*Ceriodaphnia dubia* has a 4 day median lethal concentration of 1,400 mg/L). Exposure to such concentrations may occur in small streams located in heavily populated urban areas with dense road networks and elevated salt loadings, in ponds and wetlands adjacent to roadways, near poorly managed salt storage depots, and at certain snow disposal sites". Environment Canada has concluded that "road salts that contain inorganic chloride salts with or without ferrocyanide salts are "toxic" as defined in Section 64 of *CEPA*".

Sanding

The application of sand to provide increased traction during winter conditions (*i.e.*, snow and ice) may lead to increases in sedimentation of watercourses.

Proposed Trans-Canada Highway Presence

During the Project related activities associated with proposed TCH presence, there is a potential for a change in water quantity, and therefore habitat quantity and quality. The contribution to runoff from the highway RoW will be more episodic, compared to the more gradual release of water from forested/vegetated areas, however, the potential for a substantive change in the quantity of surface water due to the highway construction is low because the surface area of the highway is relatively small compared to the area of the watersheds upgradient of the crossings of most of the watercourses. Water quality may also be affected by this interaction as runoff from pavement may be warmer than receiving waters and may contain higher concentrations of suspended sediments.

Construction of the highway could contribute to a change in the distribution of water, such as a cut and fill resulting in water being redirected to another watershed.



5.4.5.1.3 Maintenance

Proposed TCH Maintenance

Maintenance of the proposed TCH may create dust and other sediment that may enter watercourses. Maintenance of watercourse crossing structures may also introduce sediments from maintenance activities (*e.g.*, installing new liners) or may resuspend sediments when culvert blockages (*e.g.*, brush and leaves) are removed.

Vegetation and Wildlife Maintenance

Hydroseeding

Hydroseeding may result in small amounts of nutrients (*e.g.*, nitrate and phosphate) entering surface waters.

5.4.5.1.4 Accidents, Malfunctions and Unplanned Events

Accidents, malfunctions and unplanned events that may occur in association with the Project and have adverse environmental effects on Fish and Fish Habitat include:

- hazardous material spills;
- erosion and sediment control failure;
- bridge or culvert washout; and
- fire.

Hazardous material spills may damage fish habitat and/or cause direct mortality of fish. Hazardous material spills could be the result of construction activities (*e.g.*, equipment fuelling or faulty vehicle components), operation activities (*e.g.*, hazardous material transport truck accident, or excessive salt application), or maintenance activities (*e.g.*, equipment fuelling).

Erosion and sediment control measures could fail and release sediment into watercourses during precipitation events.

Bridge or culvert washout may cause the loss or degradation of fish habitat, and direct mortality of fish. This could result from storms greater than accounted for in the structure design.

Fire could remove riparian vegetation near watercourses. Fire may also temporarily elevate water temperature and increase sedimentation. Fire may be caused as a result of construction activities (*e.g.*,



hot equipment), operation activities (e.g., discarded cigarettes or hot exhaust systems in contact with roadside vegetation), and maintenance activities (e.g., hot equipment).

5.4.5.2 Environmental Effects Analysis and Mitigation

The criteria for characterizing the magnitude of environmental effects are described in the key for each phase of the Project. The criteria for characterizing the geographic extent of environmental effects are as follows:

- $< 1 \text{ km}^2$ (includes the fish and fish habitat within 100 m of a single watercourse crossing);
- $1\text{-}10 \text{ km}^2$ (includes the fish and fish habitat within a 500 m of a single watercourse crossing);
- $10\text{-}50 \text{ km}^2$ (includes the fish and fish habitat within 500 m downgradient of the RoW);
- $50\text{-}100 \text{ km}^2$ (includes the fish and fish habitat within 500 m either side of the RoW);
- $100\text{-}1,000 \text{ km}^2$ (includes the fish and fish habitat between the RoW and the Saint John River); and
- $>1,000 \text{ km}^2$ (includes all fish and fish habitat within the Upper Saint John River Valley).

5.4.5.2.1 Construction

During construction of the proposed TCH and associated roads and structures, several activities could result in environmental effects on Fish and Fish Habitat. These include:

- activities that involve disturbance to soils and removal of vegetative cover that leads to an increase in erosion and sediment rates and amounts (site preparation, road preparation, watercourse crossing structure installation);
- removal of habitat (watercourse crossing structure installation);
- potential excavation of sulfide bearing bedrock (roadbed preparation);
- noise and fish organ damage from blasting (roadbed preparation);
- storage and handling of hazardous materials (surfacing and finishing activities and ancillary structures and facility construction); and
- habitat avoidance due to Project-related noise (all activities).

The sections following Table 5.4.5 describes the mitigative strategies aimed at mitigating these potential environmental effects.



**Table 5.4.5 Environmental Effects Assessment Matrix for Fish and Fish Habitat
(Construction)**

Environmental Effects Assessment Matrix Valued Environmental Component: FISH AND FISH HABITAT Phase: Construction							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in fish habitat quality (A)	- Follow EPP, EFG - Site specific EPPs - Erosion control measures - Limit area of disturbance especially within 30 m of watercourse - Minimize instream work, if required work in the dry	1	4	2/1	R	2
Roadbed Preparation	Change in fish habitat quality (A) Direct mortality to fish (A)	- Follow EPP, EFG and site specific EPPs - Identify areas of sulfide bearing rock concern through sampling program - Obtain approval to blast from DFO - Follow DFO's blasting guidelines	1	4	2/6	R	2
Watercourse Crossing Structures	Change in fish habitat quantity (A) Change in fish habitat quality (A) Direct mortality to fish (A)	- Planning for watercourse installation using DFO and <i>Watercourse Alteration Technical Guidelines</i> - Apply for Watercourse and Wetland Alteration Permit, follow requirements - Follow NBDOT EPP and EFG - Develop site specific EPPs - Erosion control measures - Limit area of disturbance - Minimize instream work, if required work in the dry - Installation to occur from June 1 to September 30 - Compensation Plan if HADD determined by DFO	1	2	6/1	I	2



Table 5.4.5 Environmental Effects Assessment Matrix for Fish and Fish Habitat (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: FISH AND FISH HABITAT Phase: Construction							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Surfacing and Finishing	Change in fish habitat quality (A)	- Follow EPP and EFG - Designated fuelling and storage area should be at least 100 m from watercourse	1	3	2/6	R	2
Ancillary Facilities and Structures	Change in fish habitat quality (A)	- Follow EPP and EFG - Designated fuelling and storage area should be at least 100 m from watercourse	1	3	2/6	R	2
Key: Magnitude: 1 = <i>Low</i> : localized effect on specific group, habitat, or ecosystem, returns to pre-Project levels in one generation or less, within natural variation 2 = <i>Medium</i> : portion of a population or habitat, or ecosystem, returns to pre-Project levels in one generation or less, rapid and unpredictable change, temporarily outside range of natural variability 3 = <i>High</i> : affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation, such that communities do not return to pre-Project levels for multiple generations Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Site Preparation

Clearing and Grubbing

Clearing and grubbing will be minimized within 30 m of the watercourse. Enough vegetation must be allowed to grow along the bank of the watercourse to maintain the stability of the banks. Vegetation will also provide shade to prevent an excessive rise in water temperature. NBDOT will avoid long skids of timber on steep slopes adjacent to watercourses as well as avoid felling or skidding trees across a watercourse. Where possible, NBDOT will not use heavy machinery within 10 m of streambanks. Any trees that need to be cut within 10 m of a watercourse will be cut by hand or by machinery able to "reach in" within those areas.



As mentioned previously, erosion and sedimentation may occur during all Project phases. Erosion and sedimentation control measures and mitigation are summarized here, but apply to all phases where Project induced erosion or sedimentation is possible.

Erosion control systems will be in place to manage runoff from the construction areas. Erosion control measures are identified in Section 4.5 of the EPP and Section 4.2 of the EFG and include erosion control fencing, check dams, use of mulch (possibly from shrubs and trees removed during clearing) and, if necessary, sedimentation control ponds. As these erosion control measures also slow the transport of surface runoff, they will also increase the potential for localized infiltration to groundwater.

NBDOT will follow Section 5 of the EPP for watercourse crossing structures (including culverts), and the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b) in the design and construction of all watercourse crossings. In addition, all watercourse crossings of more than 1.2 metres in diameter, and/or more than 25 metres in length, and/or with a slope above 0.5 % will follow the Guidelines for the Protection of Fish and Fish Habitat – The Placement and Design of Large Culverts (DFO 1999a). The purpose of these guidelines is to ensure a consistent approach for the protection of fish and fish habitat at culvert locations throughout Nova Scotia, New Brunswick and Prince Edward Island. The Guideline contains information on culvert design criteria, fish species of concern, potential effects of culvert installation and supporting mitigation strategies.

The design of new streambeds and banks will be done in consultation with DFO and NBDNR. The inlet and outlet of the culvert, and any new stream channels, are stabilized against erosion by use of riprap, gabions, geotechnical fabric, seeding, mulching or a combination of these.

Suspended solids should not increase by a level exceeding 10 mg/L when background suspended solids concentrations are equal to or less than 100 mg/L (CCME 1999). Suspended solids should not increase by a level exceeding 10 % of background concentrations when background concentrations are greater than 100 mg/L. The generally accepted provincial guideline is suspended solids concentrations within effluent released should not exceed 25 mg/L (monthly average) or 50 mg/L (grab sample) above background (Washburn and Gillis 1998).

For the proposed project, sedimentation and siltation will be minimized during construction and operation with use of proper mitigative steps outlined in Section 4 of the EPP and Section 4.3 of the EFG and in the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b). Instream work will be conducted so as not to coincide with periods of increased sensitivity such as spawning and egg incubation times. In general, instream work will be conducted between June 1 and September 30, where possible. Any in-stream work occurring after September 30 would be considered an unplanned event. In such a case, appropriate permits (i.e., Watercourse and Wetland Alteration Permit and HADD



authorization) would be obtained. During this period, low water flows, and dry soil also make watercourse installation easier.

Instream work will be conducted outside of this period when seasonal weather conditions permit and where there is no anticipated environmental effect on sensitive life stages. Instream work will also occur outside of this period when work must be completed prior to the onset of winter conditions, or where the advantages of completing the work (e.g., sediment control structures) prior to winter conditions justifies late season work. In the event of instream work in sensitive watercourses outside of the June 1 to September 30 season, DFO will be consulted, and appropriate permits and authorizations (i.e., Watercourse and Wetland Alteration Permit and HADD authorization) will be obtained. Any instream work completed after September 30 will require continuous monitoring during the work period and inspection of sediment control mitigation during periods of substantial visible overland flow of water (e.g., major thaw events). Alternative sediment control mitigation may be required during the winter period. For example, floating silt barriers may be anchored into ice to trap sediment flowing on top of the ice surface (Trow Consulting Engineers Ltd. 1996). Alternative sediment control techniques will be discussed with DFO prior to authorization of late season instream work.

In addition, there will be a 30 m buffer zone adjacent to each watercourse, where clearing will only occur in areas necessary for the RoW development. Extra efforts will be made to minimize instream activities during culvert and bridge installations. If instream work is required, this work will be conducted in the dry using cofferdams, temporary diversions, or pumping flow around the construction site. Details on these approaches are outlined in the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b).

Runoff controls limit or contain soil movement from the construction site. Minimizing raindrop impact on the soil, reducing runoff volume, and decreasing runoff velocity are three of its main objectives. Diversion berms will be used on slopes to intercept sheet flow on exposed surfaces and to reroute flow into undisturbed areas. Erosion protection will be implemented at the berm outlets. Flow checks will be constructed in ditches, swales, or chutes to reduce hydraulic gradient and flow velocity, thus minimizing the potential erosion of the channel.

In the event of late season work (i.e., after September 30), stabilization of exposed soils within the Work Area will be completed:

- within 5 days of disturbance within 30 m of a watercourse (using mulch or another approved late season stabilization material), or prior to any forecasted winter storm event and/or the onset of frozen ground conditions; or



- within 30 days of disturbance beyond 30 m of a watercourse as per Item 946 of the Standard Specifications (NBDOT 2003), or prior to any forecasted winter storm event and/or the onset of frozen ground conditions, when possible.

Erosion protection measures are used to reduce or eliminate the suspension and removal of soil particles by flowing water. These measures will be placed on or applied to the soil surface and in conjunction with runoff control and sediment interception measures as appropriate. Various geomembranes and geotextiles will be used to minimize erosion as appropriate. In addition, revegetation will occur on slopes and embankments for long term stabilization.

Soil loss from slopes may occur even with erosion and runoff control measures. To prevent this soil from entering a waterbody, mitigative measures will be implemented to intercept it. Methods that will be used to trap sediment include vegetated buffer strips, silt fences, filter berms and sediment traps. Monitoring of erosion control structures will be conducted to ensure the structures remain in place and operate effectively throughout the construction period. Specifically, all structures will be inspected prior to and following any rainfall event, and at least daily during prolonged periods of rainfall. Erosion control measures will not be removed until the exposed areas have been stabilized by vegetation.

During construction, a wet weather shut down policy will be in place to avoid soil disturbance during runoff periods. In addition, a watercourse monitoring program will be developed in consultation with DFO, which will include total suspended solids and pH (where the potential for sulfide bearing rock drainage exists).

The mitigation for minimizing the potential interaction between clearing and grubbing activities and sulfide bearing rock is described in Section 5.3.5.2.1 of Surface Water.

Based on consideration of the potential environmental effects of the individual activities required for RoW preparation of the proposed TCH and associated roads and facilities, the proposed mitigation [e.g., EPP, EFG, site specific EPPs, *Watercourse Alteration Technical Guidelines* (NBDELG 2002b), and *Guidelines for the Protection of Fish and Fish Habitat – The Placement and Design of Large Culverts* (DFO 1999a) and the residual environmental effects significance ratings criteria, the environmental effects on fish and fish habitat by site preparation activities are considered not significant.

Roadbed Preparation

Blasting

Blasting will be avoided where possible but in some instances it may be unavoidable. Should blasting be required during construction in or near a watercourse, authorization will be required from DFO for



the use of explosives (Section 32 of the *Fisheries Act*). Blasting will be conducted in accordance with the EPP and EFG and *Guidelines for use of Explosives in Canadian Fisheries Waters* (Wright and Hopky 1998), and in full compliance with the requirements of DFO's authorization.

Environmental effects from blasting to fish and fish habitat can be minimized through use of these mitigative measures, which include but are not limited to:

- consultation with DFO Regional authorities during the planning process;
- exclusion of fish from the blasting area, where practical, using appropriate methods (e.g., noise generated with an air compressor discharge line);
- use of non-propagating explosives;
- use of time-delay blasting caps for detonation of multiple, smaller charges;
- no use of ammonium nitrate-fuel oil mixtures in or near water due to the production of toxic ammonia;
- recovery of all residual blasting components (e.g., shock tubes and detonation wire); and
- no explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change greater than 100 kPa in the swimbladder of a fish.

Construction (including blasting) in or near watercourses will be undertaken between June 1 and September 30, outside of the biologically sensitive period to avoid the sensitive and critical fish life stages, where possible.

The mitigation for minimizing the potential interaction between clearing and grubbing activities and sulfide bearing rock is described in Section 5.3.5.2.1 of Surface Water.

Based on consideration of the potential environmental effects of the individual activities required for roadbed preparation of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs, *Watercourse Alteration Technical Guidelines* (NBDELG 2002b), and *Guidelines for the Protection of Fish and Fish Habitat – The Placement and Design of Large Culverts*), and the residual environmental effects significance ratings criteria, the environmental effects on fish and fish habitat by roadbed preparation activities are considered not significant.

Watercourse Crossing Structures

A design exercise was completed for each watercourse crossing, regardless of watercourse size, along the proposed highway to evaluate the drainage area upstream of the proposed crossing, fish populations within the watercourse, and precipitation. The results will be used to meet Watercourse and Wetland Alteration Permit requirements, and review by DFO.



As part of the design process, a Watercourse and Wetland Alteration Permit will be obtained from NBDELG. Conditions associated with the permit will be met by NBDOT. Generally, watercourse crossings (if constructed with proper mitigation) do not violate the *Fisheries Act* and therefore do not require habitat compensation under DFO's *No Net Loss Policy*. However, final approval is required from DFO regarding the overall Project, and the proposed individual watercourse crossings. If DFO determines that there will be a harmful alteration disruption or destruction to fish habitat (HADD), then a habitat compensation plan will be required to ensure the policy is met. In addition, Coast Guard approval under the *Navigable Waters Protection Act* will be required for proposed crossings over navigable waters.

Mitigation for the potential HADD of fish habitat required by DFO for similar highway projects in New Brunswick includes:

- watercourse crossings in fish bearing watercourses will be designed in consultation with DFO;
- the area of disturbance will be limited to that which is absolutely necessary to complete the Project;
- all work will be done in strict accordance with conditions of approval;
- an onsite pre-construction meeting with DFO, NBDNR, and NBDELG to review conditions of authorization will be held;
- all streambeds and streambanks associated with the proposed work will be permanently restored as soon as possible following disturbance;
- a wet weather shut down policy will be in place and will include the minimum forecast intensity/duration rainfall event which will evoke the implementation of response measures;
- instream work or any work within 30 m of a watercourse will not be done outside of the period between June 1 and September 30 of each year without written permission from DFO and NBDELG;
- work conducted outside the June 1 to September 30 time period will be subject to conditions/requirements determined by DFO on a site-specific basis (*i.e.*, HADD authorization, NBDOT inspector to oversee work on a continuous basis);
- a fish salvage will be conducted by a qualified biologist prior to de-watering;
- a Compliance Monitoring Plan will be developed prior to commencement of any construction activity; and
- all culverts and temporary and permanent stream diversions associated with the project works allow for fish passage.

NBDOT is committed to address the issue of fish habitat compensation as required through the development of a "habitat bank". "Habitat banking" is the completion of compensation prior to authorization, whereby the proponent (NBDOT) creates or improves fish habitat for future use as compensation when the project is carried out. The creation of a habitat bank does not involve monies, nor does it "pre-approve" any future HADD authorizations. The value (in area units) of the compensation is determined at the time of the withdrawal. DFO regional staff and NBDOT have agreed



to a maximum required ratio of 3:1 for offsite habitat compensation for this Project. This means that for each (1) unit of habitat requiring authorization, up to three units of habitat must be enhanced or created in consultation with and as authorized by DFO. Changes to the construction of watercourse crossings (e.g., design, schedule, construction methodology) which require amendments to the *Fisheries Act* authorizations may also require additional habitat compensation.

Prior to initiation of the habitat banking process, a HADD compensation plan will be developed by NBDOT, and include:

- the process by which the requirement for compensation will be minimized;
- the process by which compensation projects will be selected;
- the process by which compensation will be carried out;
- a compliance monitoring plan;
- an effectiveness monitoring plan; and
- a schedule for the completion of sufficient compensation prior to authorization.

Monitoring required in the plan would include compliance monitoring to ensure that compensation is being carried out correctly, and effectiveness monitoring to ensure that compensation achieved a net gain in productive capacity.

Compensation, requiring an authorization under Section 35(2) of the *Fisheries Act*, for the loss of fish habitat required by DFO for similar highway projects in New Brunswick includes:

- identification of who will carry out work and if any landowners are involved;
- development of an approved compensation plan;
- the compensation plan must be implemented before the end of the authorization period;
- a post construction monitoring plan will be developed and implemented;
- all planted material will be maintained for the duration of the post production monitoring program;
- all planted material will be native to New Brunswick;
- all instream enhancement works will be maintained for the duration of the post production monitoring program;
- results from post construction plan will be summarized yearly and submitted to DFO; and
- as-built drawings for the channel re-alignments, culvert installations and compensation works will be provided to DFO within one year.

DFO has advised that in most cases, the installation of box or pipe culverts is the preferred approach to minimizing habitat loss. Section 2.2.3 describes the types of watercourse crossing structures that may be used, and the criteria for the selection of a particular type. The following watercourses may require a large structure (e.g., arch or bridge):



- Big Presque Isle Stream (WC33);
- Little Presque Isle Stream (WC36 and WC37);
- River de Chute (WC18);
- Upper Guisguait Brook (WC20);
- Lower Guisguait Brook (WC24); and
- Hunters Brook (WC32).

A complete list of watercourse structures is included in Surface Water, Section 5.3.

All watercourse crossing structures will be installed in compliance with the conditions set in the site specific watercourse alteration permit. Bridge design and installation will be done in consultation with DFO and the Canadian Coast Guard (Navigable Waters Protection Program).

The installation of culverts will be done using dam and pump procedures or channel diversion. In either case, fish will be removed from the area of planned construction activities prior to construction commencing. This will be done by enclosing the area of planned construction activities with fine-mesh nets and removing the fish using DFO approved methods (e.g., electrofishing or seine nets). Direct mortality of some fish can be expected at rates consistent with those typical for electrofishing and the use of barrier nets. Water pump intakes – used during dam and pump procedure – will be in compliance with the DFO *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995b).

During construction, an on-site monitor (environmental inspector) will ensure that the installations are conducted according to the planning process, meet the Conditions of Approval as described in the Watercourse and Wetland Alteration Permit and do not introduce suspended sediments or contaminants to surface waters.

Based on consideration of the potential environmental effects of the individual activities and physical works required watercourse crossing structures for the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., habitat compensation), and the residual environmental effects significance ratings criteria, the environmental effects on the fish and fish habitat by these activities are considered not significant.

Surfacing and Finishing, and Ancillary Structures and Facilities Construction

The management of hazardous materials will be mitigated as described in Section 5.3.5.2.1 of Surface Water.

Based on consideration of the potential environmental effects of the individual activities and physical works required for surfacing and finishing and construction of ancillary structures and facilities along



the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), and the residual environmental effects significance ratings criteria, the environmental effects of construction of fish and fish habitat by these activities are considered not significant.

5.4.5.2.2 Operation

The following provides an evaluation of key potential project-VEC interactions for the operation phase of the Project as summarized in the environmental effects assessment matrix (Table 5.4.6). Operation of the proposed TCH will continue in perpetuity upon completion of the construction phase of the project. The main issues in this phase of the project related to fish and fish habitat are proposed TCH presence (long term erosion, sedimentation and runoff), and winter safety (i.e., use of salt and sand for snow removal and providing traction). Further discussion follows the table.

Table 5.4.6 Environmental Effects Assessment Matrix for Fish and Fish Habitat (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: FISH AND FISH HABITAT Phase: Operation							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in habitat quality (A)	Develop and implement long term salt management plan	1	3	2/2	R	2
Proposed TCH Operation	Change in habitat quality (A) Change in habitat quantity (A)	- Proper design of cut and fills, and ditching - Follow EPP and EFG	1	3-4	5/6	R	2
Key: Magnitude: 1 = <u>Low</u> : localized effect on specific group, habitat, or ecosystem, returns to pre-Project levels in one generation or less, within natural variation 2 = <u>Medium</u> : portion of a population or habitat, or ecosystem, returns to pre-Project levels in one generation or less, rapid and unpredictable change, temporarily outside range of natural variability 3 = <u>High</u> : affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation, such that communities do not return to pre-Project levels for multiple generations Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Winter Safety

The application of salt and sand to improve safety during winter weather conditions will be mitigated as described in Section 5.3.5.2.2 of Surface Water.



Based on consideration of the potential environmental effects of the individual activities required for winter safety along the proposed TCH and associated roads and facilities, the proposed mitigation [e.g., EPP, EFG, salt management plan], and the residual environmental effects significance ratings criteria, the environmental effects on fish and fish habitat by these activities are considered not significant.

Proposed TCH Presence

Erosion and sedimentation and runoff from the road surface will be mitigated as described in Section 5.3.5.2.2 of Surface Water.

Culverts and bridges can lose their ability to provide fish passage through accumulation of debris, or through erosion. Culverts and bridges will be inspected, cleaned and repaired on a regular basis, to help ensure proper fish passage, and to maintain the integrity of the structure. Watercourse Alteration Permits will be applied for any activities at these crossings. The maintenance or construction activities will be conducted according to the requirements specified in the Watercourse Alteration Permit. Section 5 of the EPP and Section 6 and 7 of the EFG protection measures will be implemented. Erosion control measures shall be installed as required, and removed material from the watercourse will be disposed of in such a way as to prevent material from re-entering the structure.

Based on consideration of the potential environmental effects of the individual activities and physical works associated with the presence of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, salt management plan), and the residual environmental effects significance ratings criteria, the environmental effects on fish and fish habitat by these activities are considered not significant.

5.4.5.2.3 Maintenance

Routine highway maintenance that may potentially interact with fish and fish habitat includes ditching, vegetation control and watercourse crossing structure repairs. Further discussion, by Project phase, follows Table 5.4.7.



Table 5.4.7 Environmental Effects Assessment Matrix for Fish and Fish Habitat (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: FISH AND FISH HABITAT Phase: Maintenance							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-cultural and Economic Context
Proposed TCH Maintenance	Change in habitat quality (A)	- Follow EPP and EFG - Follow requirements of Watercourse Alteration Permits - Follow necessary erosion control measures - Maintain buffer zone within 30 m of watercourse	1	3	5/6	R	2
Vegetation and Wildlife Management	Change in habitat quality (A)	- Follow EPP and EFG - Apply for Watercourse Alteration Permits, follow requirements - Maintain buffer zone within 30 m of watercourse	1	3	5/6	R	2
Key: Magnitude: 1 = <u>Low</u> : localized effect on specific group, habitat, or ecosystem, returns to pre-Project levels in one generation or less, within natural variation 2 = <u>Medium</u> : portion of a population or habitat, or ecosystem, returns to pre-Project levels in one generation or less, rapid and unpredictable change, temporarily outside range of natural variability 3 = <u>High</u> : affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation, such that communities do not return to pre-Project levels for multiple generations Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Proposed TCH Maintenance

Ditching may be required to improve water flow, erosion or excessive vegetative growth. The primary issue of concern is the release of sediment into surface water bodies. NBDOT has identified this issue in their EPP (Section 6.1.4) and EFG (Section 4.4), and detailed protection measures to protect surface waters. The end of ditching should not come within 30 m of a watercourse. Ditches should be directed into surrounding vegetation where possible, rather than entering directly into a natural watercourse. Sediment-laden water entering fish bearing waters will comply with the *Canadian Water Quality*



Guidelines for the Protection of Aquatic Life (CCME 1999). A Watercourse Alteration Permit will be applied for any activities within 30 m of a watercourse.

Based on consideration of the potential environmental effects of the individual activities associated with the maintenance of the proposed TCH and associated roads and facilities, the proposed mitigation [e.g., EPP, EFG], and the residual environmental effects significance ratings criteria, the environmental effects on fish and fish habitat by these activities are considered not significant.

Vegetation and Wildlife Management

Vegetation control will be conducted by mechanical clearing during highway operation on the RoW (e.g., road shoulders and interchanges). As stated in the NBDOT EPP, there will be no herbicides used for vegetation control. For vegetation control activities within 30 m of a watercourse, when required, a Watercourse Alteration Permit will be obtained before initiation of activities. Slash shall not be allowed to enter any watercourse.

Any increase in watercourse nutrient levels from hydroseeding would be temporary as the applications are infrequent and these nutrient forms are readily absorbed by sediments or taken up by plants.

Based on consideration of the potential environmental effects of the individual activities associated with the vegetation and wildlife management along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), and the residual environmental effects significance ratings criteria, the environmental effects of maintenance on fish and fish habitat by these activities are considered not significant.

5.4.5.2.4 Accidents, Malfunctions and Unplanned Events

The following provides an evaluation of key potential project-VEC interactions for accidents, malfunctions and unplanned events as summarized in the environmental effects assessment matrix (Table 5.4.8). The main issues related to fish and fish habitat are hazardous materials spills, fire and bridge/culvert washout. These accidents are possible during all Project phases. Further discussion of each accident type follows the table.



Table 5.4.8 Environmental Effects Assessment Matrix for Fish and Fish Habitat (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: FISH AND FISH HABITAT Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Materials Spill	Change in habitat quality (A) Direct mortality (A)	- Follow EPP and EFG procedures and provincial and federal regulations should be followed for storage and handling of materials - Contingency Plan - Employee training	1-3	3-5	1/1	R	2
Erosion and Sediment Control Failure	Change in habitat quality (A) Direct mortality (A)	- Follow EPP and EFG preventative measures - Contingency Plan	1-2	1-5	1/1	R	2
Bridge or Culvert Washout	Change in habitat quality (A) Direct mortality (A)	- Follow EPP and EFG preventative measures - Contingency Plan	1-2	1-2	1/1	R	2
Fire	Change in habitat quality (A) Direct mortality (A)	- Follow EPP and EFG preventative measures - Contingency Plan	1-2	4-5	1/1	R	2
Key: Magnitude: 1 = Low: localized effect on specific group, habitat, or ecosystem, returns to pre-Project levels in one generation or less, within natural variation 2 = Medium: portion of a population or habitat, or ecosystem, returns to pre-Project levels in one generation or less, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation, such that communities do not return to pre-Project levels for multiple generations Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 10 - 50 km ² 4 = 50 - 100 km ² 5 = 100 - 1000 km ² 6 = >1,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Hazardous Materials Spill

Known hazardous materials that will be used during the construction and operation of the Route 2 Bypass include fuels, lubricants, solvents, windshield washer and antifreeze. There is also a possibility that a large quantity of other various unidentified hazardous materials will be transported along this route. There is a possibility that these materials could be accidentally introduced into fish habitat through a spill of these materials. These materials could temporarily degrade water quality and have subsequent environmental effects on freshwater fish. In addition, contaminants can accumulate in



sediments and be mobilized slowly over time. If a major spill of a highly toxic and soluble material were to occur at one of the watercourse crossings, the geographic extent would include both the tributary and areas downstream in the watershed, potentially downstream as far as the confluence with the Saint John River depending on the quantity and the toxicity of the material spilled. Mortalities could potentially occur at all fish life stages within the affected area. Changes in water quality could also affect other trophic levels, resulting in drift or direct mortalities of benthic organisms. Sublethal environmental effects could include avoidance behaviour and disruption of feeding and migration patterns.

The magnitude of the environmental effect of a spill would be dependent on a number of factors, which are difficult to predict. Reversibility of physical environmental effects is high, due to the dynamic nature of lotic water systems. The high spring flows and high bedload transport will effectively flush the system during the spring following the event. Reversibility of environmental effects on fish populations will depend on the species involved, and the proportion of the watershed affected. Resident fish would re-establish within the affected area.

NBDOT has spill response contingency procedures identified in Section 8.1 of the EPP and Section 5.7 of the EFG. In the unlikely event of a hazardous material spill, the spilled material will be controlled and contained, and NBDOT will assist with the clean up. Materials to facilitate a rapid containment and clean up of hazardous materials spills will be available on site during construction in or near watercourses and wetlands.

Areas NBDOT considers to be environmentally sensitive are identified in Section 7.0 of the EPP and may be particularly sensitive to pollutant spills. Watercourses, Wetlands, Rare Plants, Archaeology Sites, Wildlife Habitat, etc., are indicated by location on the various Figures included in the Comprehensive Study Report. The protective measures required to ensure the protection of sensitive areas in the case of an accident or spill are identified in Section 5.7 of the EFG. This section outlines seven steps to be taken when a spill occurs and also describes and illustrates how to control and contain spills. The seven steps include the following.

1. Identify the material involved and make a quick assessment.
2. Stop the flow of product, if it can be done safely.
3. Call the Coast Guard Environment t Emergency Number (1-800-565-1633; 25 hours). This is a legal requirement.
4. Call CANUTEC: 1-613-996-6666 (24 hours).
5. Notify DOT District Engineer or other designated representative.
6. For spills at fuelling facilities contact the DOT Supervisor, Vehicle Management Agency, Maintenance and Traffic Branch, and the local Fire Prevention Authority.
7. Control and contain spilled product until expert help arrives, if it can be done safely.



Section 8.1 of the EPP also outlines protection measures in case of a fuel or chemical spill. A brief description of the procedures to take are as follows:

- First group on the scene assumes a worst case scenario, and cordon off the area to others;
- Safely attempt to retrieve shipper's emergency telephone number from the driver or the order papers to identify the materials involved and make a quick assessment;
- Report all information at hand to headquarters or dispatcher (*i.e.*, respective of the first group on the scene) as applicable; and
- Determine if the coast Guard (1-800-565-1633) has been notified; if not, ensure that coast guard is notified giving all information at hand, so they can activate the response from DOE and the Emergency Measures Organization.

Section 4.19 of the EPP also identifies protection measures to prevent spills and accidents from occurring. Site-specific EPPs will be developed for work near environmentally sensitive areas and these will address preparedness measures that are necessary to ensure effective emergency response in the event of spills is reflective of the level of sensitivity.

The transportation of dangerous goods is discussed in Section 5.2.5.2.4. Assuming that emergency spill response plans are in place and carried out effectively, it is considered extremely unlikely (almost no chance of occurrence) that a spill event capable of producing a high magnitude environmental effect (Table 5.4.8) would occur during the life of the Project (in perpetuity). Therefore, a significant environmental effect from a large scale spill is considered possible, but extremely unlikely.

Based on consideration of the potential environmental effects of an accident, malfunction, or unplanned event, involving the release of a hazardous material into fish habitat along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, most of the environmental effects of hazardous material spills are considered unlikely and not significant. However, because of the possibility (albeit very low) of a substantial hazardous material spill of a toxic substance directly into a watercourse, the environmental effects of an accidental hazardous material spill on fish and fish habitat are considered significant, but not likely.

Erosion and Sediment Control Failure

There is a potential during heavy precipitation events or flash floods for erosion control structures (*i.e.*, check dams) to fail. To reduce the possibility of this occurring, protection measures will be followed as described in Section 4.5 of the EPP. Specifically, erosion control structures will be monitored regularly and maintained in a functional condition until the grass on seeded slopes is sufficiently established to be an effective erosion deterrent. All check dams will be inspected before and after each rainfall and at least daily during periods of prolonged rainfall. All check dams found to be damaged will be repaired



immediately. Sediment deposits retained by structures will be removed when the level of sedimentation is within 100 mm of the top of the structure.

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event, involving erosion and sediment control failure along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects of erosion and sediment control failure on fish and fish habitat would not likely result in the decline of a fish community that would not recover in one generation and are therefore considered not significant.

Bridge or Culvert Washout

There is a potential during high flood events for portions of the highway, or bridge or culvert installations to be washed out. This could temporarily degrade water quality due to increased sedimentation, or affect habitat quantity by deposition of debris material into the stream (concrete debris, bridge/culvert materials) that could affect fish passage. Factors influencing the magnitude, duration and geographic extent of the environmental effect include amount and duration of flooding, type and size of washout, natural terrain surrounding watercourse and location within the watershed. The extent of the environmental effects of such a road failure or washout on fish is predicted to be low due to the small area of a watershed which is covered by the watercourse crossing. Reversibility potential is high due to the dynamic nature of stream high spring discharges and high spring bedload transportation.

Roads are most susceptible to washouts during the high flow period during and immediately following spring snow melt. Road design will focus on protection of the aquatic environment by incorporating buffer zones, drainage and erosion control features and very conservative culvert and bridge design criteria. Watercourse crossings (bridges and culverts) will be designed with a hydraulic capacity to handle at least the 1 in 100 year peak discharge event, and will follow the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b).

Watercourse crossing structures (including culverts) will be inspected at regular intervals and repairs will be made as required as per Section 6.3 of the EPP and Section 6 and 8 of the EFG.

Based on consideration of the potential environmental effects of an accident, malfunction, or unplanned event, involving a bridge or culvert washout along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects of a bridge or culvert washout or failure on fish and fish habitat would not likely result in the decline of a fish community that would not recover in one generation and are therefore considered not significant.



Fire

A forest fire could alter water quality within streams, resulting in subsequent environmental effects on the population of freshwater fish. Fire within the Assessment Area of the highway could occur during any phase of the Project due to lightning or human activities. It is assumed, for the purposes of this assessment, that the affected area for such an event would extend to all areas downstream of the area affected by fire. Factors influencing the severity and duration of environmental effects include time of year, extent of fire damage and type of fire. Risk of forest fire along the road route is possibly higher than in non road areas due to the presence of human activity along the road route, which may be recreational or commercial in nature.

A fire during late summer or early fall could interfere with migration and spawning of salmonid species if the interaction was of long duration. During early life stages (*i.e.*, eggs, alevins), salmonids are more sensitive to the deposition of ash and sediment through runoff and have limited avoidance ability. Therefore, fires during the fall (spawning) and winter (incubation) present a greater risk to salmonid populations. If the forest fire affects a large proportion of the stream and occurs during the late fall, the magnitude of the environmental effect of such a fire could be medium for salmonids. Atlantic salmon are not known to spawn in watercourses within the watercourses crossed by the proposed TCH. Reversibility of physical environmental effects is high, but would occur over a number of years. Spring flows and high bedload transport will effectively flush the system during the spring following the event, however, erosion within the watershed would continue to contribute sediments to the stream system for a number of years. Changes to groundwater patterns and contribution to baseflow in the stream may be altered during this period due to changes in evaporation and infiltration rates. Restoration of bank stability and cool temperatures would rely on the re-establishment of riparian communities through vegetative succession. The environmental effects on the population of resident and migratory fish are reversible. Benthic drift from upper portions of the brook will re-establish food resources. For fish populations, individuals from other portions of the watershed would recolonize the areas of environmental effects.

The potential for Project-related fires during Construction and Maintenance will be mitigated through equipment maintenance (*e.g.*, power saw mufflers and vehicle exhaust systems) and proper vigilance working with power equipment in forested areas, as per Section 8.4 of the EPP. Also, any burning of vegetative debris will require permits from NBDNR and NBDELG as per Section 4.8.3 of the EFG. All Construction activities will be done in compliance with regulations contained within the *Forest Fires Act*.

The potential for Project-related fires during Operation will be mitigated through vegetation management (*e.g.*, mowing and brush cutting) as per Section 6.1.6 of the EPP.



In the event of a fire occurring as a result of Construction and Maintenance activities, NBDOT personnel shall be prepared (*i.e.*, will have access to round point shovel or fire extinguisher) to control and fight any fires in and about the work area, as per Section 7.4 and 8.4 of the EPP, and the *Forest Fires Act*. All fires will be reported to NBDNR. Forest fires not related to the Project will be managed by NBDNR.

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event, involving a fire contacting fish habitat along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects on fish and fish habitat would not likely result in the decline of a fish community that would not recover in one generation and are therefore considered as not significant.

5.4.5.3 Determination of Significance

Table 5.4.9 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and fish and fish habitat, after taking into account any proposed mitigation. The table also considers the level of confidence of the study team in this determination and the likelihood of potential environmental effects. The residual environmental effects are considered not significant for all Project phases. Potential hazardous material spills for the Project are considered significant for hazardous material spills, but unlikely.

Table 5.4.9 Residual Environmental Effects Summary Matrix for Fish and Fish Habitat

Residual Environmental Effects Summary Matrix				
Valued Environmental Component: FISH AND FISH HABITAT				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	3	3
Maintenance	NS	3	3	3
Accidents, Malfunctions and Unplanned Events	S	3	1	3
Project Overall	NS	3	3/1	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				



Based on consideration of the Project-related environmental effects, it is concluded that the fish and fish habitat resources in the vicinity of the Project have the capacity to meet the needs of the present and those of the future.

5.4.6 Monitoring and Follow-up

The primary residual environmental effect of the Project on fish and fish habitat is the potential for the sedimentation of watercourses. The loss of fish habitat from installation of watercourse crossing structures will be mitigated by ensuring no net loss of fish habitat through habitat compensation. Watercourse crossing structures will be designed to allow for fish passage as required by DFO, where possible.

The fish and fish habitat monitoring will consist of both compliance and effectiveness monitoring. During construction, compliance monitoring will ensure that all applicable environmental protection and permitting requirements for work within 30 m of a watercourse are followed, and that remedial action, if necessary, is successfully implemented. Remedial action may involve fish rescue for de-watered sections of streams and/or near blasting areas. The fish and fish habitat compliance monitoring will be the same as that described in Section 5.13.3.3 for surface water monitoring.

Effectiveness monitoring for fish and fish habitat has the following four objectives:

- verify that mitigative strategies used during construction and operation have been effective;
- determine the total amount of HADD that occurred as a result of the Project;
- verify that habitat compensation, completed as part of the habitat bank, is operating effectively; and
- identify the need for, and carry-out, any additional habitat compensation.

The exact specifications of the fish and fish habitat and surface water monitoring program will be developed in consultation with DFO and NBDELG. The monitoring program will be subject to approval by DFO as part of the HADD authorization process and NBDELG as a part of the Watercourse and Wetland Alteration permitting process. This work will be undertaken in selected streams as determined through the authorization/permitting processes. The fish and fish habitat (and surface water) effectiveness monitoring will consist of the following core elements for comparison with pre-development baseline conditions:

- assessment of fish population and diversity (short term and long term);
- assessment of fish habitat;
- assessment of invertebrate population and diversity (short term); and
- a substrate and embeddedness study.



In addition, a fish passage study will also be conducted on a small number of watercourses to verify that design strategies for fish passage were effective.

The fish habitat assessment will use the NBDNR/DFO fish habitat assessment methodology (Hooper *et al.* 1995). The fish habitat assessment will also include measurements of pH and salinity in those watercourses identified, in consultation with DFO and NBDELG, as sensitive to these parameters.



5.5 Vegetation

5.5.1 Rationale for Selection as Valued Environmental Component

Vegetation was selected as a VEC because of the potential for interactions between Project activities and the vegetated terrestrial and riparian environments. This includes species of special conservation concern, or species likely to be designated as such. This VEC also considers Appalachian Hardwood Forests that were raised as being "environmentally significant areas" in the Guidelines. In the context of this VEC, vegetation is limited to vascular plant life and will focus on species of special conservation concern as indicators of potential environmental effects on vegetation.

5.5.2 Environmental Assessment Boundaries

5.5.2.1 Spatial and Temporal

The spatial boundaries for the Project include the Project footprint, where activities associated with site preparation and construction, operation, and malfunctions and accidents of the Project could potentially result in environmental effects on vegetation. For the purposes of this assessment, vegetation within the limits of clearing for the highway asphalt surfaces and structures is assumed to be permanently removed and this environmental effect is considered irreversible. Other areas to be cleared and landscaped will generally result in a change in vegetation from forest to open habitat.

The environmental effects of vegetation loss and/or habitat degradation on species of special conservation concern are assessed within the context of the regional biogeoclimatic zone (*i.e.*, the Valley Lowlands Ecoregion) and the alternative habitat available within the zone. The environmental effects on mature Appalachian Hardwood Forest are assessed within the context of western New Brunswick, in the former extent of the historic Appalachian Hardwood Forest.

The temporal boundaries of the Project include the periods of construction, and subsequent operation and maintenance of the Project in perpetuity.

5.5.2.2 Administrative and Technical

Endangered and threatened plant species are protected federally under the *Species at Risk Act (SARA)*, as listed in Schedule 1 of the *Act*. As defined in the *SARA*, "wildlife species" means a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. The purpose



of this act is to protect wildlife species at risk and their critical habitat. *SARA* is administered by Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada.

Endangered plant species are protected provincially under the New Brunswick *Endangered Species Act*. The purpose of this act is to provide protection to endangered species and their habitats. The New Brunswick *Endangered Species Act* is administered by NBDNR. The *Endangered Species Regulations* list those plants considered endangered in the province.

Information used in support of the assessment of vegetation was obtained from NBDNR, the Atlantic Canada Conservation Data Centre (ACCDC), NBDELG, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the Nature Trust of New Brunswick (NTNB) Environmentally Significant Areas database, forest inventory mapping, orthographic maps and aerial photography (1999). Knowledge of the vegetation affected by the Project is based on rare vascular plant surveys conducted in 2002, supplementary surveys in June and July 2003, and other information provided by the above sources, and the professional judgement of the study team. Rare vascular plant surveys were carried out along the proposed TCH route to provide a current and thorough examination of baseline conditions. The proposed TCH route was divided into three sections and surveys were conducted by three teams (JWEL 2003a; ACER 2003; Dillon 2003) in 2002. If there was a route alignment change, the need for additional rare plant surveys was examined and executed as required in 2003.

Spatial habitat information used for the assessment includes the Project footprint (1,054 ha including access roads), and is defined by twenty two digital map tiles (78,894 ha) which give a larger view of the area traversed by the Project (Figure 5.8.1 in Section 5.8.2.2). This Agriculture and Forestry Assessment Area ("Assessment Area") was used for the assessment of agriculture and forestry in the Land Use, and Labour and Economy VECs. The data were obtained from the NBDNR Forest Inventory Mapping (1996/2000).

It is the professional judgement of the study team that the data that are currently available to characterize the existing conditions and the existing knowledge regarding the project-VEC interactions are sufficient to support the environmental assessment.

5.5.3 Residual Environmental Effects Rating Criteria

A *significant residual environmental effect* on rare vascular plant species (*i.e.*, those ranked S1, S2, or S3 by ACCDC and ranked "May Be At Risk" or "Sensitive" by NBDNR) or "At Risk" vascular plant species (*i.e.*, threatened or endangered plant species listed by *SARA* or the *NB Endangered Species Act*) is one that alters the terrestrial habitat within the assessment boundaries physically, chemically, or biologically, in quality or extent, in such a way as to cause a change or decline in the distribution or abundance of a viable plant population that is dependent upon that habitat, such that the likelihood of the



long-term survival of the population within the Ecoregion (Valley Lowland Ecoregion) is substantially reduced as a result.

A *significant residual environmental effect* on Appalachian Hardwood Forest is one that results in the loss of a substantive amount (greater than 10%) of mature Appalachian Hardwood Forest, or the loss of high priority (as defined by NBNT) Appalachian Hardwood Forest, in western New Brunswick.

Definitions of rarity ranks are summarized in Table 5.5.1 below.

Table 5.5.1 Definitions of Rarity Ranks

ACCDC Ranks Definitions (ACCDC 2003)	
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the species is of long-term concern (e.g. watch list). (100 + occurrences).
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (e.g., S1S2)
NBDNR General Status Rankings Definitions (NBDNR 2002a)	
At Risk	Species for which a formal assessment has been completed, and determined to be at risk of extirpation or extinction. To be described by this category, a species must be either listed as Endangered or Threatened under SARA by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or as Endangered or Regionally Endangered under the <i>New Brunswick Endangered Species Act</i> and accompanying regulations.
May Be At Risk	Species or populations that may be at risk of extirpation or extinction, and are therefore candidates for a detailed risk assessment.
Sensitive	Species which are not believed to be at risk of extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.
Secure	Species that are not believed to be At Risk, May Be At Risk, or Sensitive. These were generally species that were widespread and/or abundant. Although some Secure species may be declining, their level of decline was not felt to be a threat to their status in the province.

5.5.4 Existing Conditions

The proposed TCH will be constructed west of the existing TCH through an area dominated by steep hills and valleys. The total 70 km length of the Project was considered for the assessment. Three environmental background studies were undertaken for the Project, and the complete studies are available in JWEL (2003a), Dillon (2003) and ACER (2003).

The character of the terrestrial habitat changes from north to south along the proposed TCH. In general, the northern section between Perth-Andover and Florenceville has more topographic relief and is more forested. The southern section between Florenceville and Woodstock is a region of rolling hills and



plateaus that has been extensively cleared and is now used primarily for agriculture and grazing. The existing land use conditions are described in more detail in Section 5.8.4.

5.5.4.1 Methodology

Vascular plant surveys were completed along the proposed TCH route from Perth-Andover to Woodstock. Additional vascular plant surveys were completed by JWEL in 2003 and are reported directly in this CSR.

Field investigation methods and reporting followed guidance provided by NBDNR (M. Toner, pers. comm. 2002). Initially, aerial photography, topographic mapping, and forest inventory maps were used to select areas of potential habitat for rare vascular plants. In addition, the ACCDC was consulted to provide data on any rare or uncommon species in their database within 5 km of the alignment. Areas of interest were identified on field maps. Land features in the Assessment Area that were of specific interest for the potential to harbour rare vascular plants included ravines, alluvial flats/gravel strands, riparian habitat, intervale forest, Appalachian Hardwood Forest, cedar swamp, rich fen and other wetlands.

During the initial rare plant surveys conducted in September 2002, experienced botanists walked the proposed TCH route. Areas of active agricultural fields, with crops such as potatoes and grains, were not subjected to a vascular plant survey. While all habitats encountered along the Project footprint were searched, special effort was made to search the entire width of the RoW in areas where less common habitat types, such as riparian zones, rich slope seepages, cedar swamps, rock outcrops, talus and ledges, were encountered. Generally the less common habitat types in a landscape often tend to harbour less common and rare species.

Additional surveys were conducted in the summer of 2003 due to changes in the alignment of the proposed TCH (as of 2002). These alignment changes are described in Section 2.2. These changes were made to avoid rare vascular plants that were identified during the 2002 vegetation surveys. In addition to alignment changes, re-examination of selected previously surveyed areas were conducted June 4-15, 2003, to document the occurrence of species of concern that are not detectable in late summer. The areas resurveyed included mature hardwood stands, mature cedar stands, as well as selected rich habitats discovered during the 2002 survey. These sites were selected in cooperation with NBDNR (Species at Risk Program) and Jim Goltz prior to the field surveys, following a review of NBDOT maps and GIS-based maps showing forest cover.

All vascular plants encountered during the surveys were identified and the population status of each species was checked against lists of provincially rare species, derived from the draft status of vascular plants as designated by NBDNR (NBDNRE 2002a), the ACCDC New Brunswick Vascular Plant



Tracking List (ACCDC 2003) and the *New Brunswick Endangered Species Act*. Hinds (2000) was also used as a reference. Lists of nationally rare species found in New Brunswick were derived from COSEWIC (2003). The locations of rare vascular plants found during the survey were recorded using a GPS instrument. The number of shoots or individual plants was counted and the distributions of the rare vascular plants were mapped. Populations found in close proximity to the proposed TCH route were flagged to facilitate future identification. In areas where rare species were found within the Project footprint, similar habitats outside of the footprint were investigated to determine if the species were also present nearby. These surveys were used to help assess the potential effects of highway construction on local populations of these species.

Any vascular plant species encountered that was not definitely known were examined more closely and if possible identified in the field. If necessary, a specimen was collected to facilitate the identification of plants that could not be identified in the field. These plants were returned to the laboratory for identification. Care was taken to restrict the amount of plant material collected to the minimum required for identification. For specimens that could turn out to be uncommon or rare a GPS location was recorded.

5.5.4.2 Environmentally Significant Areas (ESAs)

Plant-based Environmentally Significant Areas (ESAs) within 2 km of the Project footprint and on the west side of the Saint John River include:

- Perth-Andover Hardwood Forest;
- Summerfield Hardwood Forest;
- Ketch Lake;
- Moody (Iron Ore) Hill Deciduous Stand; and
- Woodstock-Meduxnekeag Bridge.

The Perth-Andover Hardwood Forest is located above Andover, south of the Perth-Andover turn-off, approximately 1.2 km from the Project footprint. This site is a rich alluvial hardwood forest that contains one of only three known sites in New Brunswick for cutleaf toothwort (*Dentaria laciniata*). The Perth-Andover Hardwood Forest has been recently partially cut. Local road construction may have affected the site, however, cutleaf toothwort was recorded at the site by a botanist three years after construction was completed (J. Goltz, pers. comm.). There will be no interaction between the Project and the Perth-Andover Hardwood Forest.

The Summerfield Hardwood Forest is located just east of Summerfield, on the west side of the Saint John River. This site is a rich hardwood forest that contains fragrant black snake-root (*Sanicula*



odorata). The Summerfield Hardwood Forest is approximately 1.2 km from the Project footprint and separated by the Summerfield Road, therefore there will be no interaction with the Project.

Ketch Lake is located southwest of Charleston. Ketch Lake is a small lake associated with acid bog and fen, and numerous orchids. It is the only known site, other than one in Massachusetts, for the Dorcas Copper butterfly (*Lycaena dorcas claytoni*), which depends on bushy cinquefoil as its host. This ESA is approximately 1.5 km from the Project footprint and separated from the Project by a local road, therefore there will be no interaction with the Project.

The Moody (Iron Ore) Deciduous Stand is located west of Jacksonville, between Routes 550 and 560, approximately 1.2 km from the Project footprint. This deciduous forest community has a history of variable disturbance, resulting in densely forested lower slopes and open upper slopes. Butternut and several rare plant species are found at this site, including Goldie's fern (*Dryopteris goldiana*), showy orchis (*Galearis spectabilis*) and maidenhair fern (*Adiantum pedatum*). There will be no interaction between the Project and the Moody (Iron Ore) Deciduous Stand.

The Woodstock-Meduxnekeag Bridge is located on the banks of the Meduxnekeag River west of Woodstock, west of the bridge on the existing TCH. This site is a calcereous woods and river edge with interesting floral assemblage including rare and uncommon species such as Goldie's fern, showy orchis, yellow lady's-slipper (*Cypripedium calceolus*) and maidenhair fern. This ESA is approximately 0.5 km from the Project footprint and separated from the Project by the Meduxnekeag River.

5.5.4.3 Vascular Plant Species of Special Conservation Concern

The locations of thirty-one rare or uncommon vascular plant species encountered along the proposed TCH route during the field surveys are listed in Table 5.5.2. None of the vascular plant species recorded in the Assessment Area are listed as "At Risk" by NBDNR, or listed as threatened or endangered by SARA or the NB Endangered Species Act. Butternut (*Juglans cinerea*) was also encountered along the proposed TCH route. In November 2003, subsequent to the field surveys conducted for the Project, butternut was designated endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003). Although butternut is considered by COSEWIC to be widespread in southern Ontario, Quebec and New Brunswick, this species has been designated endangered because of a projected decline due to butternut canker (COSEWIC 2003). Butternut will likely be considered for inclusion as an endangered species in Schedule I of the SARA. Butternut is further discussed in Section 5.5.4.3.4. Most of the rare vascular plants encountered were associated with five particularly rich habitats encountered during the survey in the northern half of the alignment (Figure 5.5.1-A and 5.5.1-B, Appendix D; and Figures 5.5.2, 5.5.3, 5.5.4, 5.5.6, and 5.5.7). Each rare species is discussed below.

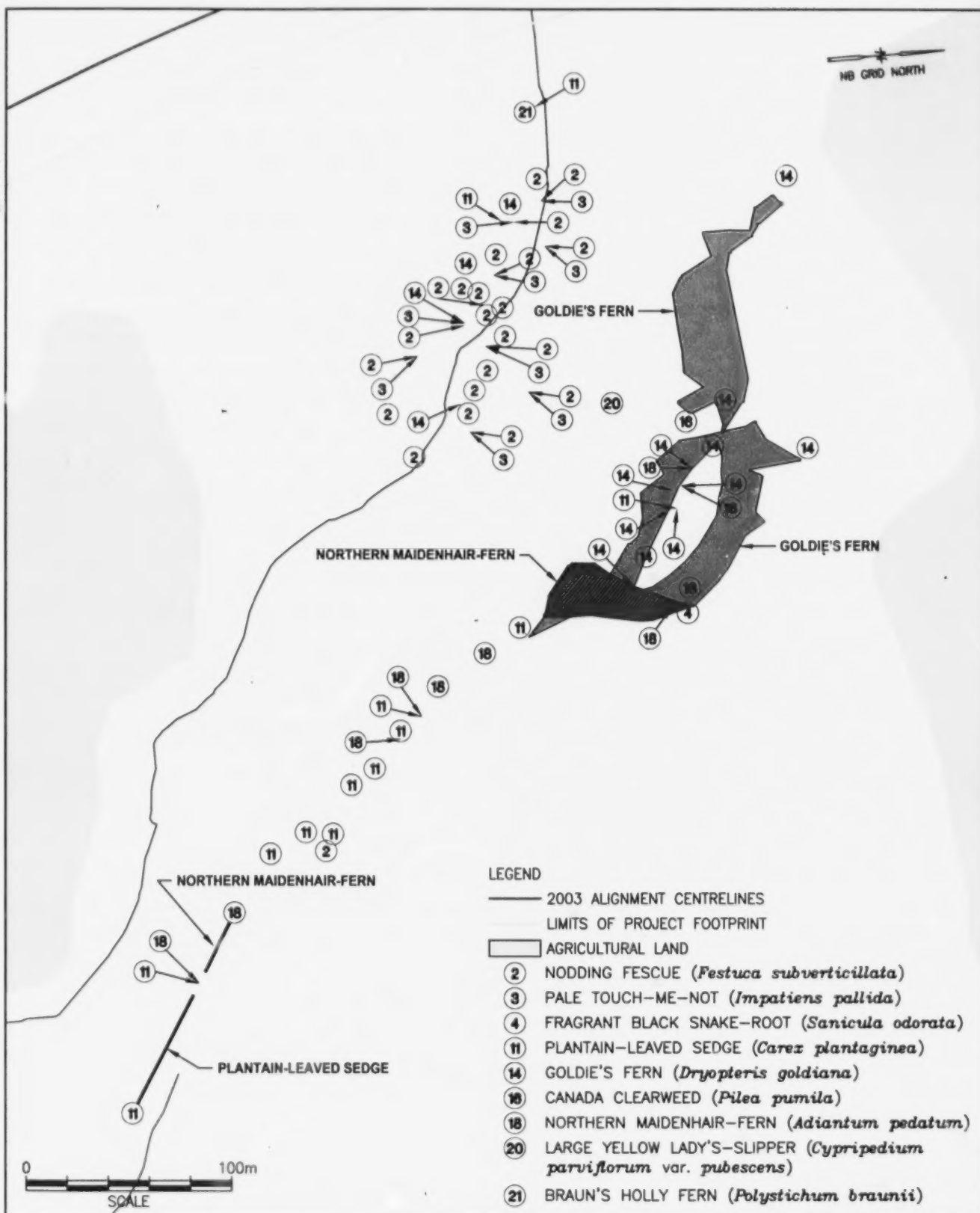


Table 5.5.2 Rare and Uncommon Vascular Plant Species Recorded along the Proposed TCH Route, Including all Areas Surveyed in 2002 Prior to Route Changes

Code Number	Scientific Name	Common Name (Comments)	ACCDC Rank	NBDNR Status
1	<i>Elymus hystrix</i>	bottle-brush grass (one rich area; outside Project footprint)	S1	May Be At Risk
2	<i>Festuca subverticillata</i>	nodding fescue (one rich area; outside Project footprint)	S1	May Be At Risk
3	<i>Impatiens pallida</i>	pale touch-me-not (one rich area; outside Project footprint)	S1	May Be At Risk
4	<i>Sanicula odorata</i>	fragrant black snake-root (single specimen; outside Project footprint)	S1	May Be At Risk
5	<i>Dirca palustris</i>	leatherwood (three areas; outside Project footprint)	S1S2	May Be At Risk
6	<i>Viola canadensis</i>	Canada violet (one rich area; outside Project footprint)	S1S2	May Be At Risk
7	<i>Calypso bulbosa</i>	calypso or Venus' slipper (two locations at one site; single plant inside Project footprint)	S2	May Be At Risk
8	<i>Valeriana uliginosa</i>	mountain valerian (one location; outside Project footprint)	S2	May Be At Risk
9	<i>Agrimonia gryposepala</i>	hooked agrimony (two locations identified; inside Project footprint)	S2	Sensitive
10	<i>Carex magellanica</i> ssp. <i>magellanica</i>	boreal bog sedge (few scattered at Wetland 18; outside Project footprint)	S2	Sensitive
11	<i>Carex plantaginifolia</i>	plantain-leaved sedge (eight areas; five outside Project footprint)	S2	Sensitive
12	<i>Carex sprengelii</i>	Sprengel's sedge (one small patch; outside Project footprint)	S2	Sensitive
13	<i>Cypripedium reginae</i>	showy lady's-slipper (several patches in cedar stand; most locations outside Project footprint)	S2	Sensitive
14	<i>Dryopteris goldiana</i>	Goldie's fern (11 areas; seven outside Project footprint)	S2	Sensitive
15	<i>Phryma leptostachya</i>	lopseed (two rich areas; one inside, one outside Project footprint)	S2	Sensitive
16	<i>Pilea pumila</i>	Canada clearweed (recorded at three locations within two rich sites, as well as in 13 wet basins; most locations outside Project footprint)	S2	Sensitive
17	<i>Utricularia minor</i>	lesser bladderwort (at two locations; one inside, one outside Project footprint)	S2	Sensitive
18	<i>Adiantum pedatum</i>	northern maidenhair-fern (53 locations within seven general areas; most locations outside Project footprint)	S3	Sensitive
19	<i>Botrychium lanceolatum</i> var. <i>angustisegmentum</i>	lance-leaf grapefern (recorded at one location; outside the Project footprint)	S3	Sensitive
20	<i>Cypripedium parviflorum</i> var. <i>pubescens</i>	large yellow lady's-slipper (66 locations in 16 general areas; most outside Project footprint)	S3	Sensitive
21	<i>Polystichum braunii</i>	Braun's holly fern (two locations; one inside, one outside Project footprint)	S3	Sensitive
22	<i>Ranunculus gmelinii</i> var. <i>purshii</i>	small yellow water-crowfoot (five locations; one inside Project footprint)	S2	Secure
23	<i>Gratiola neglecta</i>	clammy-hedge-hyssop (four locations in two areas; two locations inside, two outside Project footprint)	S2S3	Secure
24	<i>Sparganium natans</i>	small-fruited burreed (found within Wetland 3 with <i>Utricularia minor</i> ; inside Project footprint)	S2S3	Secure
25	<i>Caulophyllum thalictroides</i>	blue cohosh (20 locations in four general areas; most outside Project footprint)	S3	Secure
26	<i>Carex rosea</i>	rosy sedge (four locations; all within Project footprint)	S3	Secure
27	<i>Listera cordata</i>	heartleaf twayblade (two locations; one inside and one outside Project footprint)	S3S4	Secure
28	<i>Parnassia glauca</i>	fen grass-of-Parnassus (one plant found near <i>Valeriana uliginosa</i> on the Big Presque Isle Stream; outside of the Project footprint)	S3	Secure
29	<i>Plantago rugelii</i>	black-seed plantain (recorded at two locations, and noted at several others; inside Project footprint)	S3	Secure
30	<i>Carex cryptolepis</i>	hidden-scaled sedge (one area; outside Project footprint)	S3	Secure
31	<i>Carex diandra</i>	lesser tussock sedge (one area; outside Project footprint)	S3	Secure
32	<i>Juglans cinerea</i>	Butternut (three risk areas, 11 other locations, inside and outside Project footprint)	S3	Sensitive







**RARE PLANT CONCENTRATION
SOUTH OF BEACONSFIELD ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 12

Job No.:
14677

Scale:
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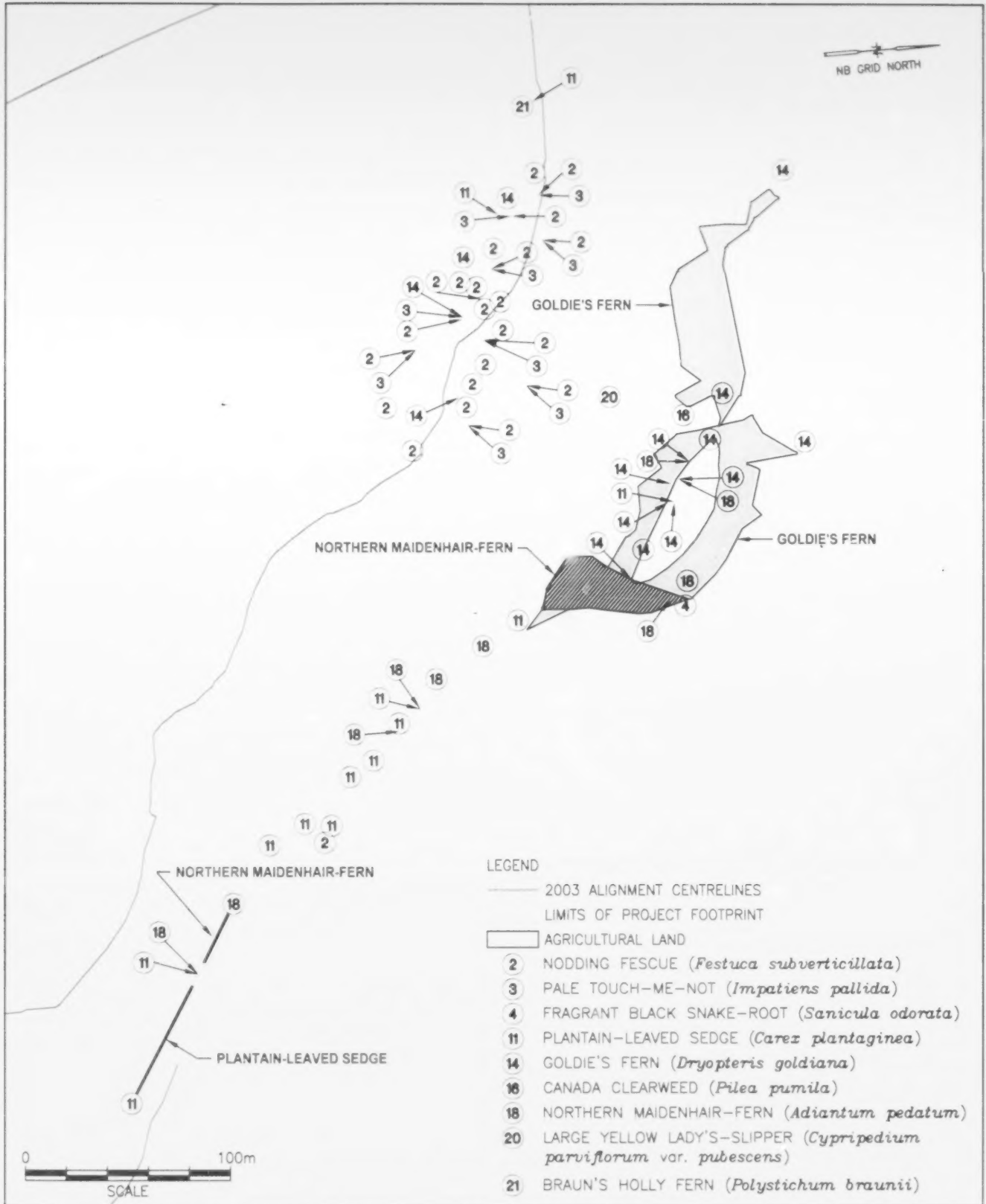
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RARE PLANT CONCENTRATION
SOUTH OF BEACONSFIELD ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 12

Job No.:
14677

Scale:
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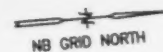
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LEGEND

- 2003 ALIGNMENT CENTRELINES
- LIMITS OF PROJECT FOOTPRINT
- WETLAND
- ⑧ CANADA VIOLET (*Viola canadensis*)
- ⑪ PLANTAIN-LEAVED SEDGE (*Carex plantaginea*)
- ⑫ SPRENGEL'S SEDGE (*Carex sprengelii*)
- ⑭ GOLDIE'S FERN (*Dryopteris goldiana*)
- ⑮ LOPSEED (*Phryma leptostachya*)
- ⑯ CANADA CLEARWEED (*Pilea pumila*)
- ⑱ NORTHERN MAIDENHAIR-FERN (*Adiantum pedatum*)
- ⑳ LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)



**RARE PLANT CONCENTRATION
NORTH OF DEMERCHANT BROOK
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 12
Job No.:
14677

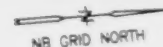
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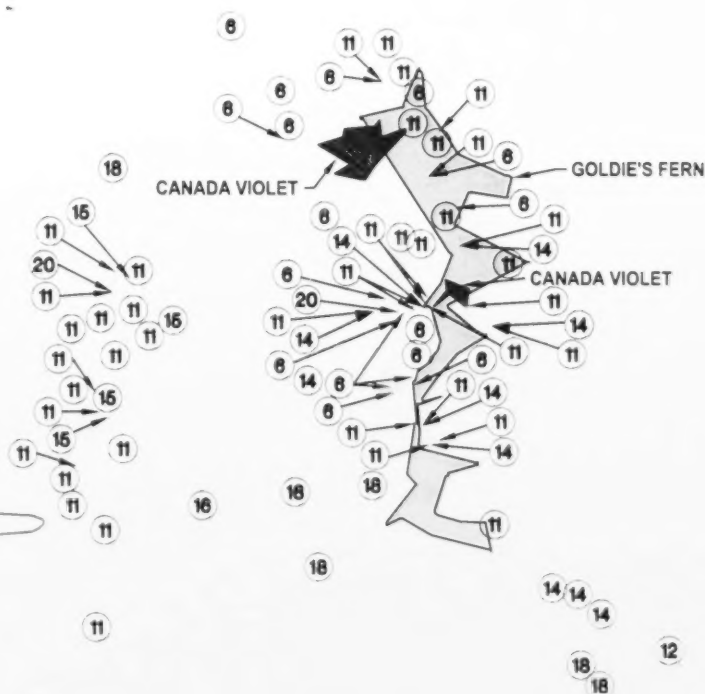
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LEGEND



- 2003 ALIGNMENT CENTRELINES
- LIMITS OF PROJECT FOOTPRINT
- WETLAND
- ⑧ CANADA VIOLET (*Viola canadensis*)
- ⑪ PLANTAIN-LEAVED SEDGE (*Carex plantaginea*)
- ⑫ SPRENGEL'S SEDGE (*Carex sprengelii*)
- ⑭ GOLDIE'S FERN (*Dryopteris goldiana*)
- ⑮ LOPSEED (*Phryma leptostachya*)
- ⑯ CANADA CLEARWEED (*Pilea pumila*)
- ⑱ NORTHERN MAIDENHAIR-FERN (*Adiantum pedatum*)
- ⑳ LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)



RARE PLANT CONCENTRATION
NORTH OF DEMERCHANT BROOK
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 12

Job No.:
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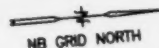
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LEGEND

- 2003 ALIGNMENT CENTRELINES
- LIMITS OF PROJECT FOOTPRINT
- ⑪ PLANTAIN-LEAVED SEDGE (*Carex plantaginea*)
- ⑭ GOLDIE'S FERN (*Dryopteris goldiana*)
- ⑱ NORTHERN MAIDENHAIR-FERN (*Adiantum pedatum*)
- ⑳ LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)



**RARE PLANT CONCENTRATION
NORTH OF BRYSON BROOK
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 12

Job No.:
14677

Scale:
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Fig. No.:
5.5.4

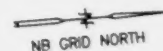


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LEGEND



- 2003 ALIGNMENT CENTRELINES
 — LIMITS OF PROJECT FOOTPRINT
- ⑪ PLANTAIN-LEAVED SEDGE (*Carex plantaginea*)
 ⑭ GOLDIE'S FERN (*Dryopteris goldiana*)
 ⑱ NORTHERN MAIDENHAIR-FERN (*Adiantum pedatum*)
 ⑳ LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)



**RARE PLANT CONCENTRATION
 NORTH OF BRYSON BROOK
 NEW ROUTE 2 TRANS-CANADA HIGHWAY
 PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 12

Job No.:
14677

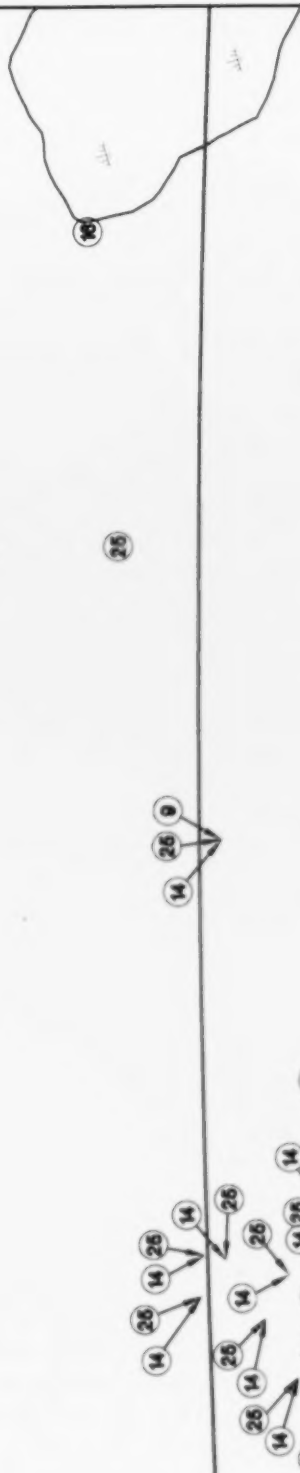
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2003 ALIGNMENT CENTRELINES

LIMITS OF PROJECT FOOTPRINT

WETLAND

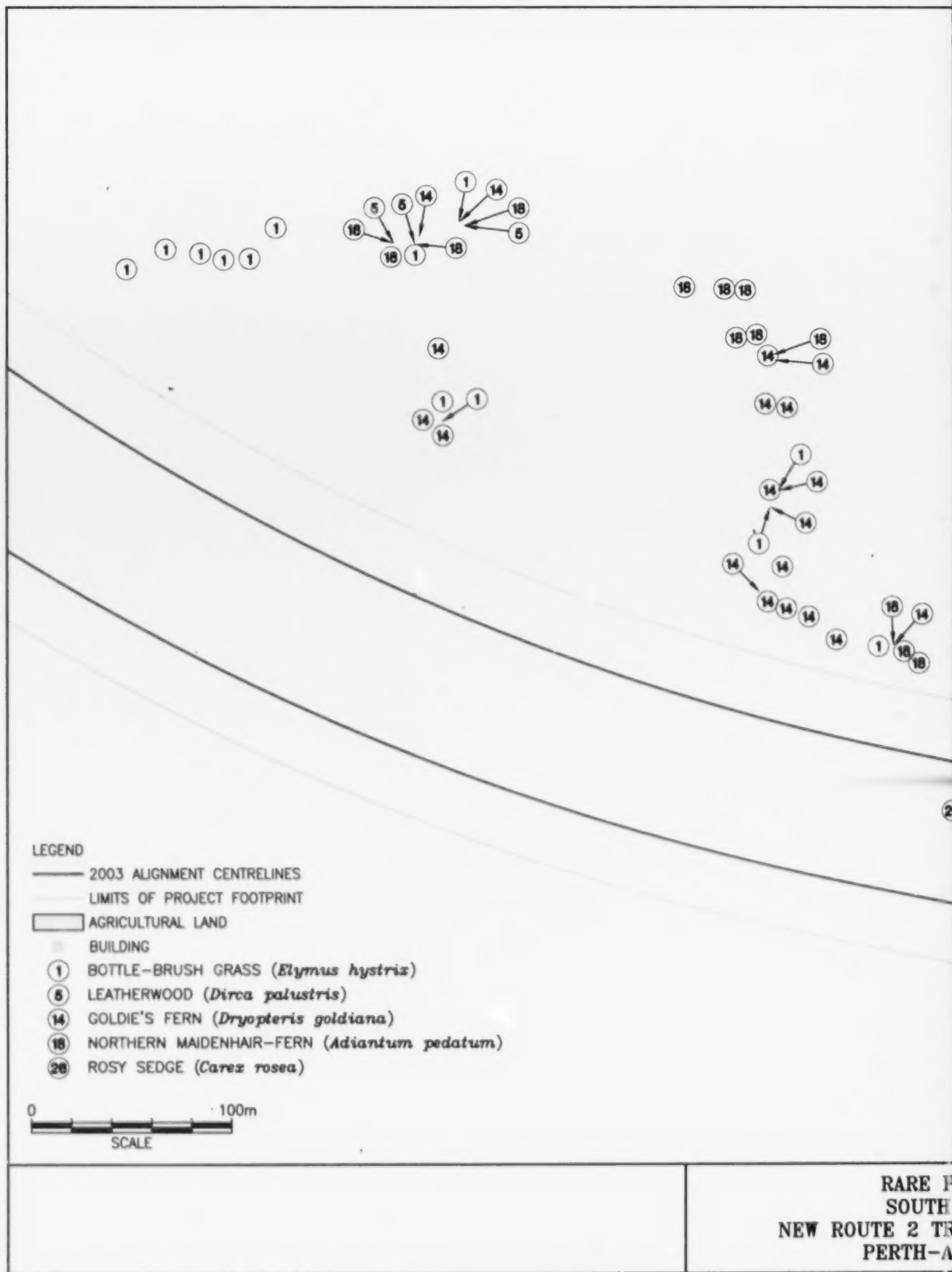
- (9) HOOKED AGRIMONY (*Agrimonia gryposepala*)
- (14) GOLDIE'S FERN (*Dryopteris goldiana*)
- (16) CANADA CLEARWEED (*Pilea pumila*)
- (20) LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)
- (26) BLUE COHOSH (*Caulophyllum thalictroides*)

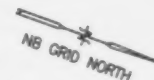


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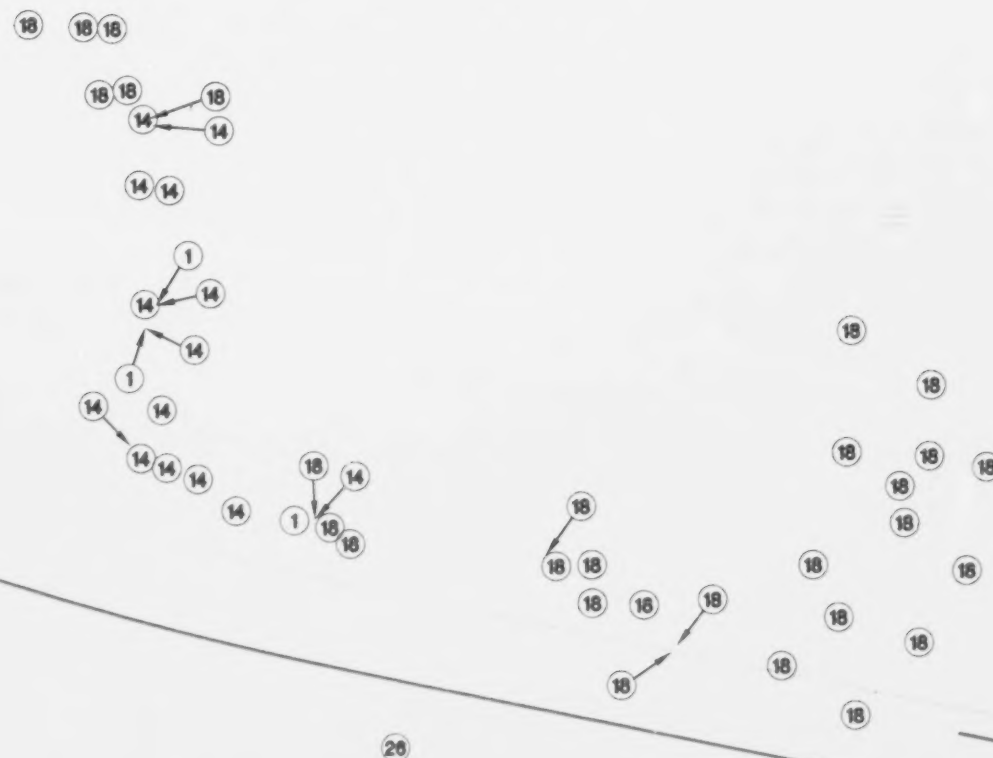
RARE PLANT CONCENTRATION
SOUTH OF DEAN ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK





EXISTING ROUTE 560

RIVER DE CHUTE



RARE PLANT CONCENTRATION
SOUTH OF RIVER DE CHUTE
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:

2004 02 12

Scale:

1 : 2500

Job No.:

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Fig. No.:

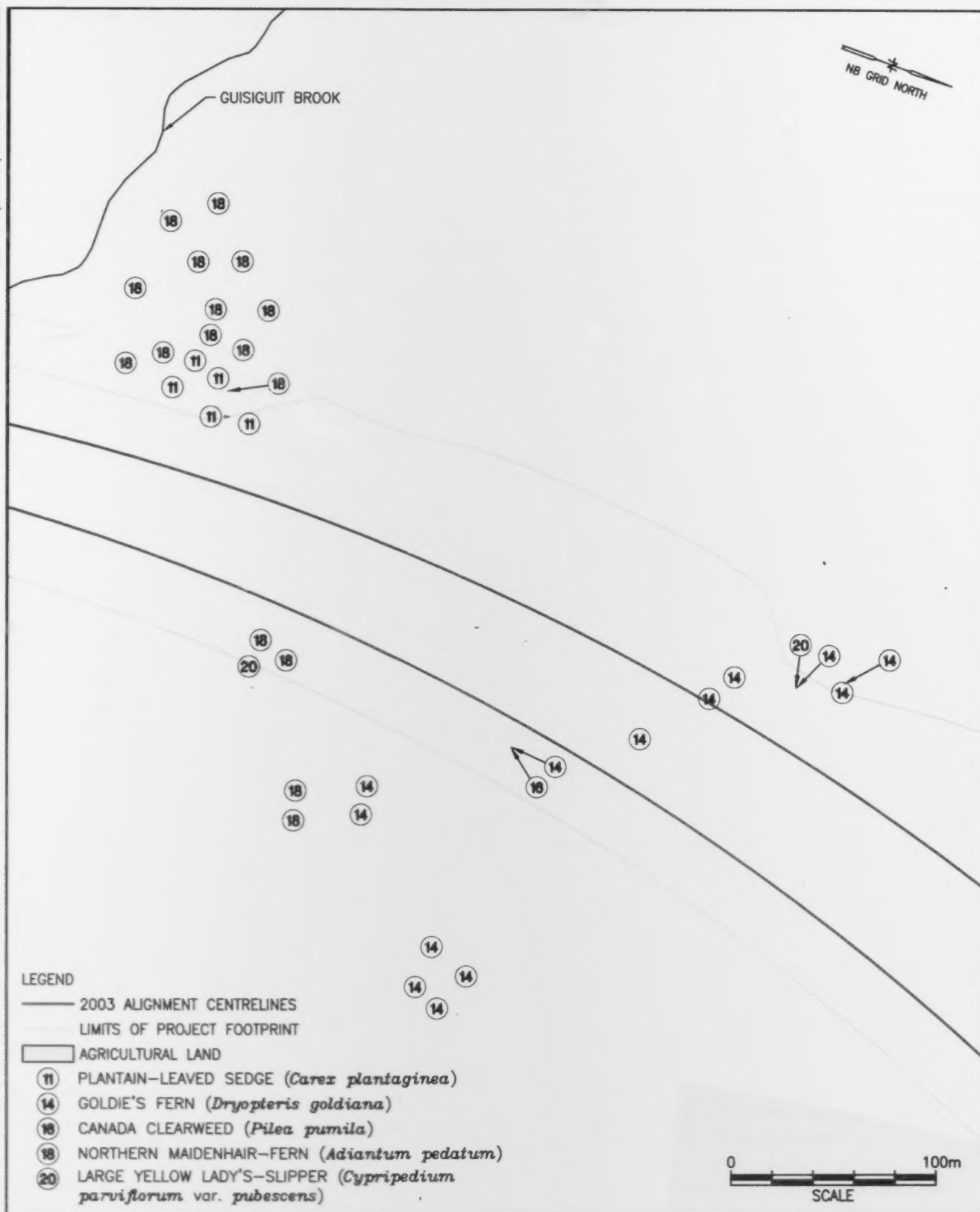
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**RARE PLANT CONCENTRATION
NORTH OF GISIGUIT BROOK
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 12

Job No.:
14677

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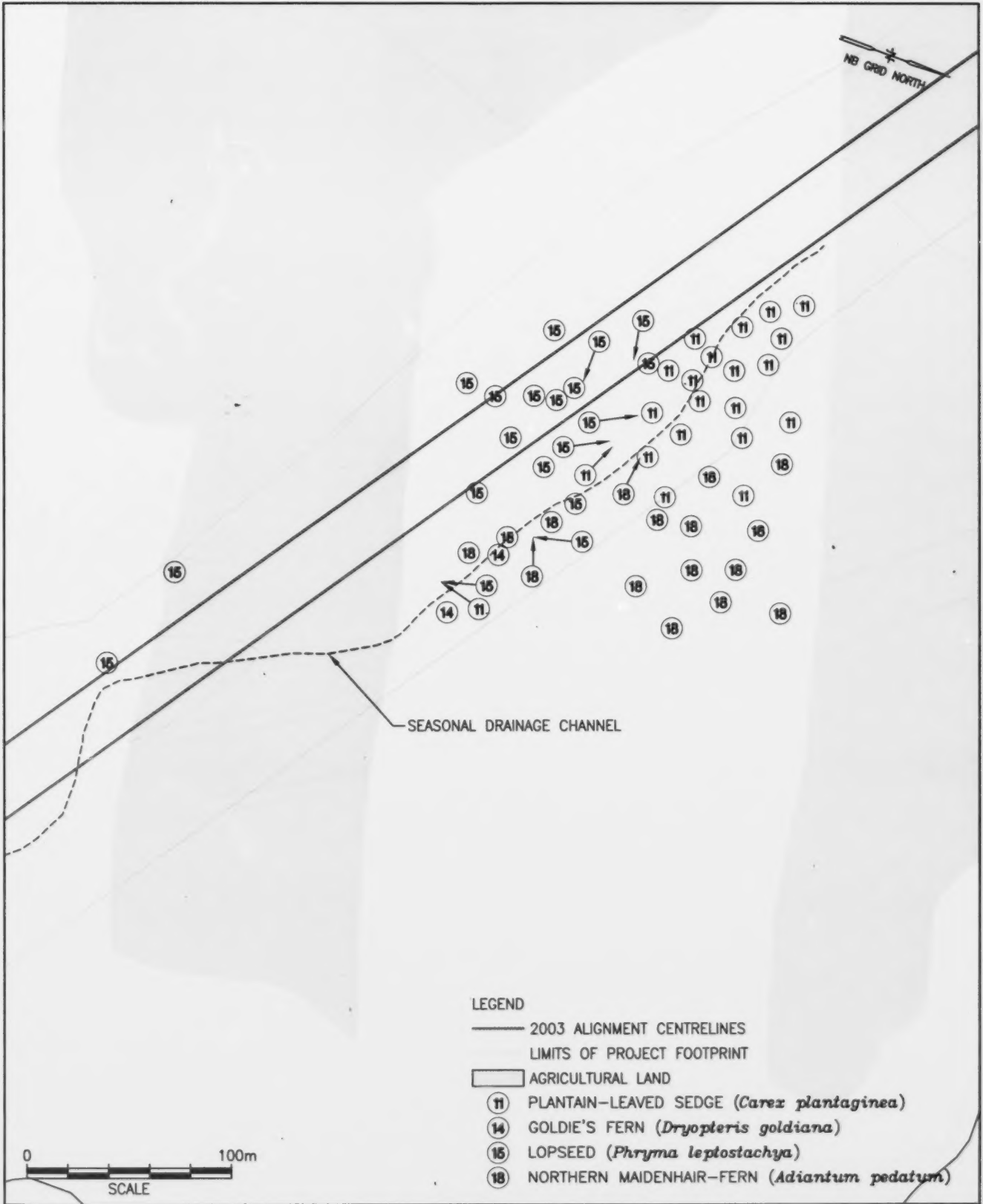
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RARE PLANT CONCENTRATION
SOUTH OF STAIRS ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 12

Scale:
1 : 2500

Job No.:
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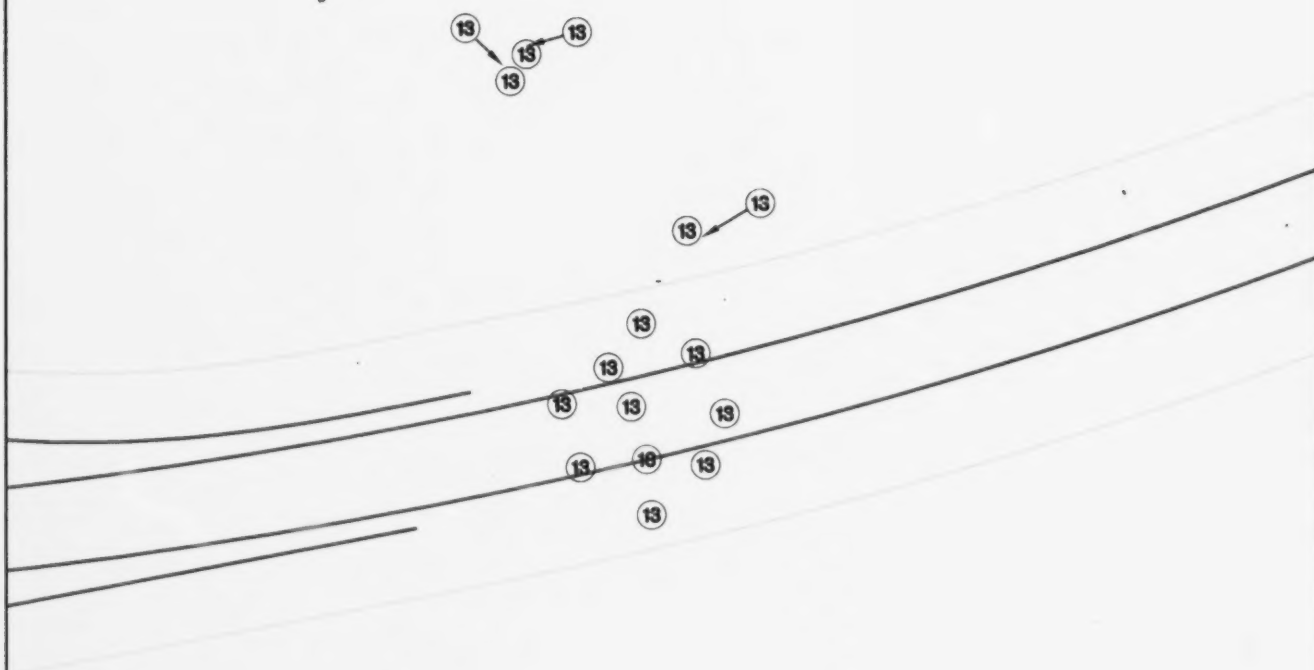
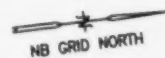
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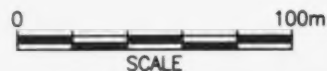
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LEGEND

- 2003 ALIGNMENT CENTRELINES
- LIMITS OF PROJECT FOOTPRINT
- ⑬ SHOWY LADY'S-SLIPPER (*Cypripedium reginae*)



**RARE PLANT CONCENTRATION
NORTH OF LITTLE PRESQUE ISLE STREAM
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2003 10 03

Job No.:
14677

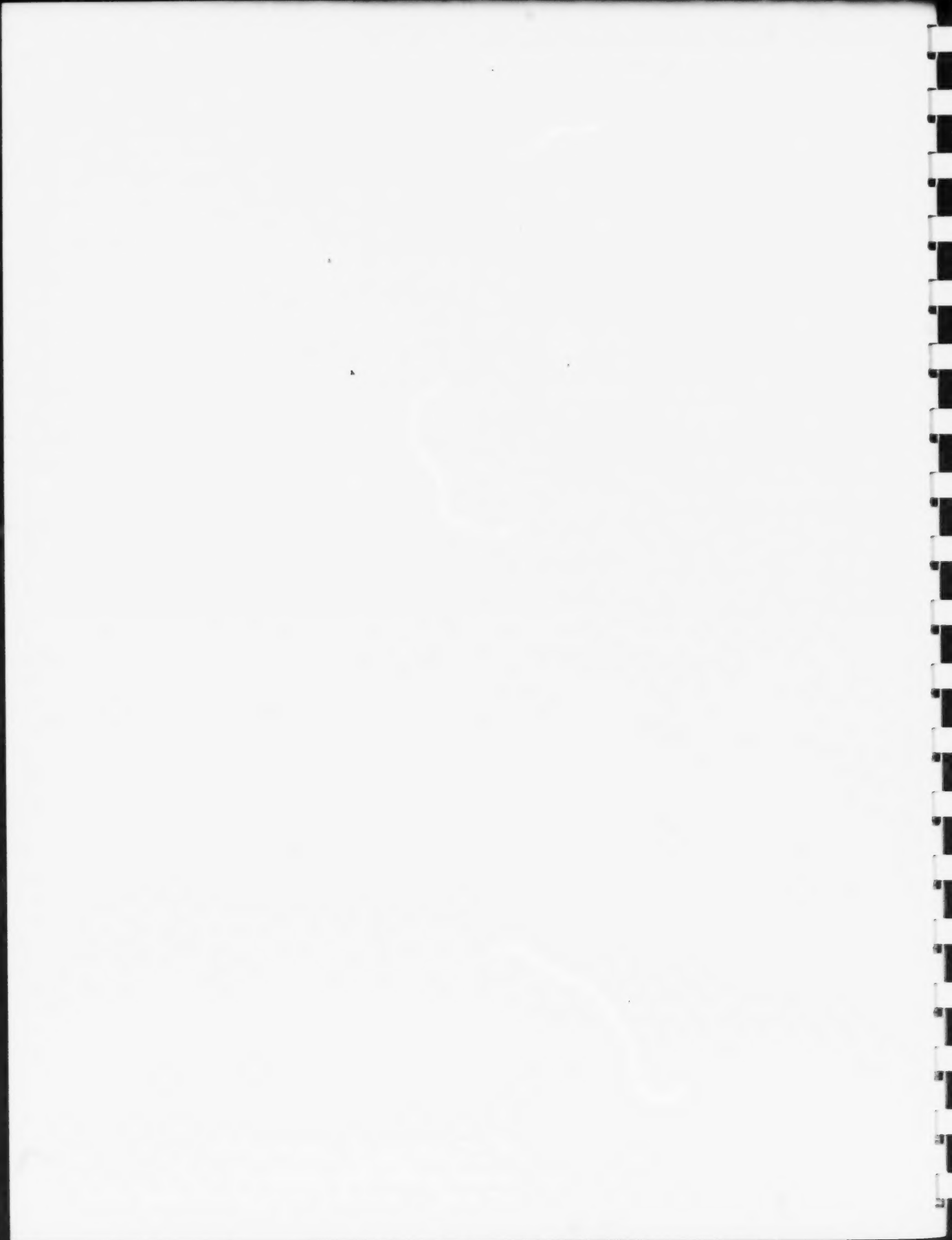
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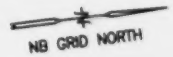
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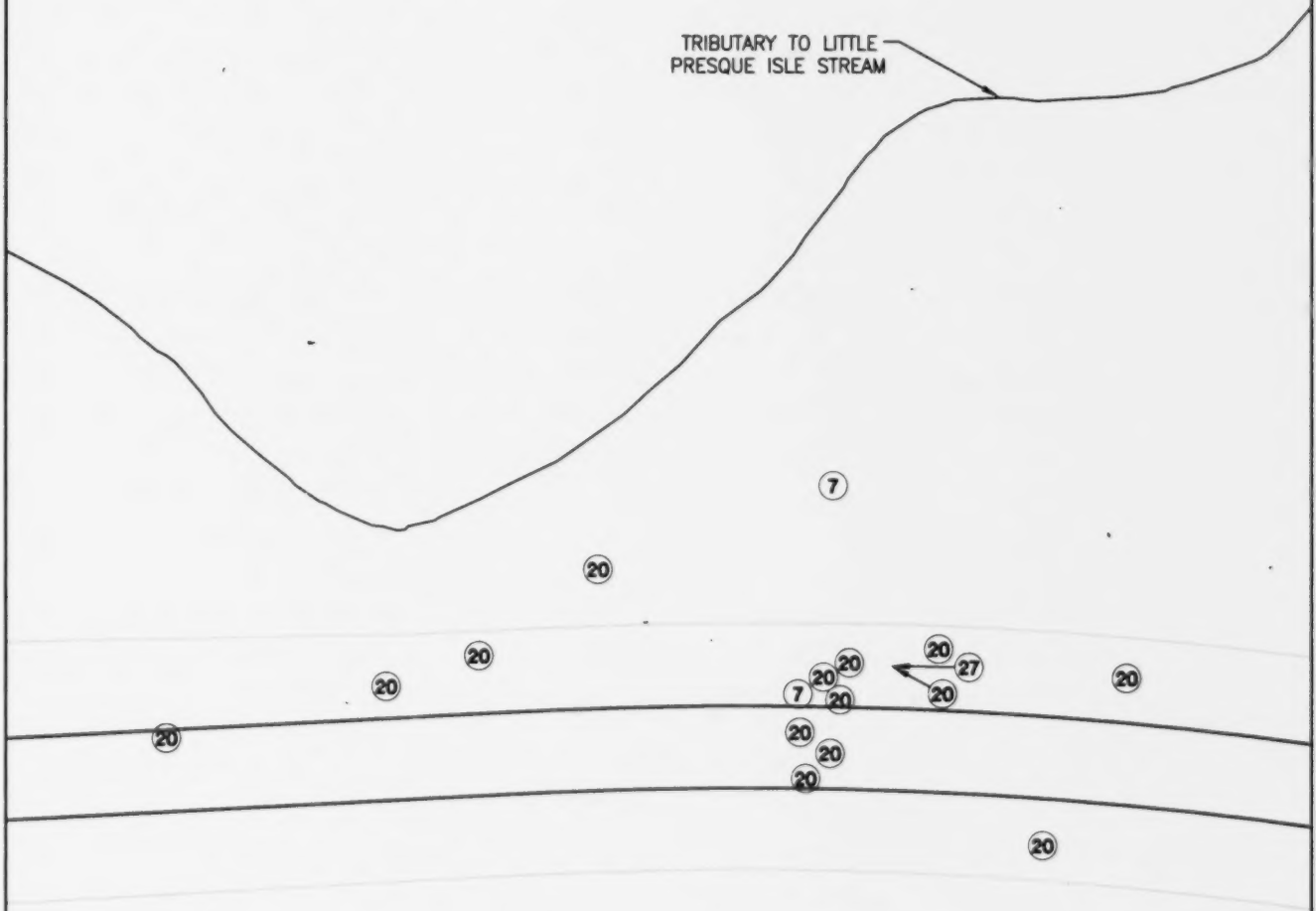
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TRIBUTARY TO LITTLE
PRESQUE ISLE STREAM



LEGEND

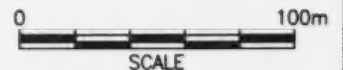
— 2003 ALIGNMENT CENTRELINES

— LIMITS OF PROJECT FOOTPRINT

⑦ CALYPSO OR VENUS' SLIPPER (*Calypso bulbosa*)

②① LARGE YELLOW LADY'S-SLIPPER (*Cypripedium parviflorum* var. *pubescens*)

②⑦ HEARTLEAF TWAYBLADE (*Listera cordata*)



**RARE PLANT CONCENTRATION
NORTH OF PALMER ROAD
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2003 10 05

Scale:
1 : 2500

Job No.:
14677

Fig. No.:
5.5.10



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5.5.4.3.1 "May Be At Risk" Species

Bottle-brush Grass (*Elymus hystrix*)

As of 1998 (MacDougall and Loo 1998), bottle-brush grass was known from only four locations in New Brunswick. Three of these locations are in Carleton County (Eel River, Jackson Falls, and Reid's Lake) and the fourth site is on the Upsalquitch River near Grog Brook. The Eel River population was revisited in 2003 and found to have a relatively large population along the river (M. Toner, pers. comm.). This species is listed as S1 by the ACCDC (2003) and is considered by NBDNRE (2002a) to be "May Be At Risk". Bottle-brush grass is typically found in rich hardwoods and clearings.

In the Assessment Area it was found at one site approximately 400 m south of Route 560 (Figure 5.5.1-B, Appendix D, and Figure 5.5.6). A total of 435 plants were recorded at this site. Five sub-populations of bottle-brush grass were found at the site. One patch consisted of 28 plants growing on the edge of a clearing at the junction of three woods roads. These plants were all found growing on the boundary between the clearing and the surrounding immature rich hardwood forest. They were typically associated with Goldie's fern (*Dryopteris goldiana*). This patch is located approximately 18 m outside of the proposed Project footprint.

The second patch of bottle-brush grass was found in a small clearing approximately 150 m south of the first cluster and consisted of 11 plants. These plants were found in the centre of the clearing in a dense growth of herbaceous species, which included large numbers of Goldie's fern. All of these plants were found outside the Project footprint.

The third patch contained 149 plants and was also found in a vegetated clearing associated with a woods road, near the cutline of an earlier alignment. The cover of herbaceous vegetation was also heavy at this site. Three other rare or sensitive vascular plant species were found at this location including leatherwood (*Dirca palustris*), maidenhair-fern (*Adiantum pedatum*) and a few Goldie's fern. This patch is located outside of the proposed Project footprint.

The fourth patch of bottle-brush grass was found south of the third cluster and consisted of 246 plants. This patch is located outside of the proposed Project footprint.

The fifth patch of bottle-brush grass was found north of the first patch and consisted of one plant. This plant is located the closest to the alignment, only approximately 20 m outside the Project footprint.

The results of the field survey suggest that this species prefers areas that are exposed to sunlight and very fertile. The presence of the entire population along logging roads in an area harvested approximately 15 years ago suggests that it is capable of surviving relatively heavy anthropogenic



disturbance. The field observations also suggest that this species is able to tolerate competition from other herbaceous species but does not tolerate heavy shade. Similar habitat preferences were noted for bottle-brush grass on the Eel River (JWEL 1997; M. Crowell, pers. comm. 2003). At this location bottle-brush grass was found in open riparian woodlands with a heavy herbaceous ground cover.

Nodding Fescue (*Festuca subverticillata*)

Nodding fescue is known from four sites in New Brunswick (MacDougall and Loo 1998) including Jackson Falls in the Meduxnekeag River valley, and Reid's Lake just west of the alignment, as well as two sites in the Restigouche River Valley. This species is listed as S1 (ACCDC 2003) and is considered "May Be At Risk" (NBDNRE 2002a).

During the 2003 field survey conducted along the modified alignment south of Beaconsfield Road near Perth-Andover, nodding fescue was found approximately 0.8 km south of the Beaconsfield Road, near the rich hardwood stand identified in 2002 by JWEL (Figure 5.5.1-A, Appendix D, and Figure 5.5.2). This is a new record for this species. Two populations were found at this location. A large population containing 98 plants was found approximately 75 m east of the proposed TCH route. None of these plants were located within the Project footprint, although are within the 1999 alignment. Each plant consisted of an aggregation of stems, which ranged in number from 1 to 40. Lower numbers of stems per plant were typically found under heavy shade where competition was more intense. This population occupied two habitat types, rich riparian forest and recent clear-cut. Five percent of the plants in this population were found in the rich riparian forest habitat along the floodplain of a small brook. At this location, nodding fescue was associated mainly with Canada nettle (*Laportea canadensis*) and silvery spleenwort (*Deparia acrostichoides*).

Several other rare and uncommon species were associated with nodding fescue at the second location including pale touch-me-not (*Impatiens pallida*), plantain-leaved sedge (*Carex plantaginea*), Goldie's fern, and Braun's holly fern (*Polystichum braunii*). Within this habitat type, nodding fescue was found at two locations. Ninety-five percent of the nodding fescue was found in a recent clear-cut located immediately adjacent to the rich riparian forest habitat. The clear-cut appeared to be approximately three years old and was not heavily vegetated. The nodding fescue growing on the clear-cut was more vigorous than the plants found in the intact forest, presumably due to reduced competition for light, water and nutrients. These plants were typically taller and had larger numbers of stems. This would suggest that this species is able to cope with the physical disturbance and changes in light, water and nutrient availability associated with forest harvesting. However, there is some uncertainty as to how well this species will cope with increased competition with tree, shrub and ground vegetation species as the clear-cut becomes fully colonized. Older clear-cuts adjacent to this one support extremely dense plant cover. It is likely that the number of nodding fescue will be substantially reduced but the species probably will not be eliminated from this habitat since it appears to be shade tolerant. All of the plants



present in the area have been flagged so it would be relatively easy to monitor this population during the early stages of secondary succession.

The proposed highway has been re-routed in this area to avoid this and two other rich hardwood sites south of Beaconsfield Road, and therefore nodding fescue will not be directly affected by the Project footprint.

Pale Touch-Me-Not (*Impatiens pallida*)

Pale touch-me-not, when not in bloom closely resembles the similar spotted touch-me not (*I. capensis*), and non-flowering plants can be difficult to distinguish in the field. Pale touch-me-not habitat is generally more calcium rich and often somewhat dryer than the diversity of moist relatively rich habitats occupied by spotted touch-me-not, but the two species can be seen either in close proximity or occasionally growing together. Hinds (2000) and MacDougall and Loo (1998) characterize the habitat for this species as rich, moist and seepy, occasionally rocky calcareous woods and meadows. In Tennessee the species has been noted growing in pure stands on thin but moist humus over limestone ledge outcrops in rich mixed forest.

In New Brunswick, five locality records are shown (Hinds 2002), with one in Carleton County, three from Victoria County and one from Restigouche County. The ACCDC (2003) classes the species as S1, and NBDNRE (2002a) places it in the "May Be At Risk" category.

Pale touch-me-not was encountered at one general location along the proposed TCH route in a rich area around a seasonally intermittent stream located south of the Beaconsfield Road (Figure 5.5.1-A, Appendix D, and Figure 5.5.2). Associated species included Goldie's fern (*Dryopteris goldiana*), wood nettle (*Laportea canadensis*), plantain-leaved sedge (*Carex plantaginea*), silvery spleenwort fern (*Deparia acrostichoides*) and other species characteristic of calcareous soils. In the location where the majority of pale touch-me-not plants were discovered (100's of plants scattered in clumps about a rich sloping stream interval), a frequent associate was the rare nodding fescue. Much of the tree cover had been removed by timber harvesting within the last one or two years, from the majority of the pale touch-me-not population distribution. While all or most of the pale touch-me-not population was located within the disturbed area of the original routing of the highway, the population is now avoided by the new routing.

Fragrant Black Snake-root (*Sanicula odorata*)

Fragrant black snake-root is a rare species ranked S1 (ACCDC 2003) and considered "May Be At Risk" (NBDNRE 2002a). This species is considered very rare by Hinds (2000). Fragrant black snake-root is



associated with rich hardwood forest habitats (Hinds 2000). MacDougall and Loo (1998) indicate that fragrant black snake-root has been recorded from five locations, all in Carleton County.

A single specimen of fragrant black snake-root was noted within the rich hardwood stand south of Beaconsfield Road (Figure 5.5.1-A, Appendix D, and Figure 5.5.2). This is a new record for this species in Victoria County. The fragrant black snake-root was located outside the original Project footprint, and is now more than 300 m from the re-aligned route.

Leatherwood (*Dirca palustris*)

MacDougall and Loo (1998) indicate that leatherwood has been recorded scattered between Woodstock and Beechwood in Carleton County, and was previously known only as far north as Reid Lake. It has also been found in York County at two sites near Fredericton and at a site in Albert County near Weldon. Leatherwood is classed as S1S2 (ACCDC 2003) and "May Be At Risk" (NBDNRE 2002a). Three leatherwood populations were found during the field surveys, near Reid Lake, River de Chute and Big Presque-Isle Stream. The Reid Lake population was found approximately 200 m east of the proposed highway, outside of the proposed Project footprint (Figure 5.5.1-B, Appendix D). It consisted of 20 plants growing in a depression in a mature sugar maple/American beech stand at the edge of a small swale. The previously discovered Reid Lake population is located west of the alignment.

The second population was found approximately 450 m south of Route 560 (Figure 5.5.1-B, Appendix D, and Figure 5.5.6). This population was located within the 1999 Project footprint, however, the proposed TCH route has recently been shifted to the east such that this population is well outside of the footprint of the Project. Sixteen plants were recorded at this location. Many of these plants were seedlings. This population was found in an immature rich sugar maple stand approximately 15 years old. At this site leatherwood was associated with several other rare and uncommon vascular plants including bottle-brush grass, Goldie's fern and maidenhair-fern.

The third population was found along Access Road "J" located north of Big Presque Isle Stream (Figure 5.5.1-C, Appendix D). Leatherwood was found approximately 400 m north of the point where the access road crosses Hunter Brook. This population was found in a mature stand dominated by balsam fir and yellow birch located at the edge of a hay field. Sixty-two plants were recorded at this location. The population was distributed from the top of the slope at the edge of the field, down slope to a poorly drained depression near a small swale. Most plants were found in the depression although none were found in the marsh. The proposed access road has been shifted to the west into the field such that it avoids this population of leatherwood.



Canada Violet (*Viola canadensis*)

Canada violet is a rare species considered borderline between S1 and S2 (ACCDC 2003), and considered "May Be At Risk" (NBDNRE 2002a). This species is associated with rich forest habitats. Although it is relatively common from central Canada westwards, Canada violet is a rare species in the Maritimes, where it is now known only from New Brunswick, though there have been several historical records from Nova Scotia. In Nova Scotia the last known record was from limestone deposits near Windsor, and as of 2001 the plant has been considered extirpated. In New Brunswick, the habitat for Canada violet is rich deciduous woods. Populations have been recorded from Carleton County (seven records in the Meduxnekeag River valley) and Victoria County (one record in the St. John River valley) (Hinds 2000, MacDougall and Loo 1998). River de Chute is on the boundary between Victoria County to the north and Carleton County to the south. Many of these New Brunswick records are quite old, and Canada Violet may no longer be found at some of these locations (S. Blaney, pers. comm. 2002).

Canada violet was found at one very rich site within the Project footprint (Figure 5.5.1-A, Appendix D, and Figure 5.5.3). This location is a new record for this species in Victoria County. The total population at this site is estimated at 1,570 plants distributed within 21 distinct patches, including one large patch containing an estimated 500 plants. The habitat consists of a rich hardwood slope dominated by butternut, sugar maple, American ash and ironwood. This habitat was situated on a shallow seepage track located near the base of a large hill. Canada-violet was found on relatively dry areas along this seepage track. At this site Canada violet was associated with a variety of rare or uncommon herbaceous vascular plant species typically found within the Appalachian Hardwood Forest (AHF). These species include Goldie's fern, plantain-leaved sedge, northern maidenhair-fern, yellow lady's-slipper, and blue cohosh. Other more common species characteristic of rich deciduous forest were also found at this site including smooth yellow violet, bloodroot, silvery spleenwort, Dutchman's-breeches, and wild ginger (*Asarum canadense*, uncommonly scattered in New Brunswick, though locally common in some locations). Rerouting of the proposed TCH route now avoids this site.

The microhabitats hosting Canada violet colonies appeared to be low hummocks which were often occupied almost exclusively by this violet. Patches of bare soil were often present (September 2002) and may indicate either allelopathic effects (*i.e.*, inhibition of plant growth by chemicals of another species) or the presence of spring ephemeral species that had ceased growth and died back. While the superficially similar smooth yellow violet was often found in the general vicinity of Canada violet it only rarely appeared to grow directly with the Canada violet. Smooth yellow violet appeared to occupy moister areas than the Canada violet. In general the Canada violet occupied the drier more open hummocks on this rich slope. Canada violet like many violets is primarily myrmecochoric or ant dispersed. Ants are attracted to oily or protein rich tissues presented on the outside of the seed and drag the seed off to the ants' nests. Seeds dislodged from their arils along the way or discarded on nutrient rich ant middens are thus dispersed from the parent plants. Ant dispersal may limit the ability of Canada



violet to spread to suitable habitats. However, other ant-dispersed species such as other violet species and bloodroot are much more widely dispersed on the landscape. This would suggest that a specific requirement for calcium rich soils, in conjunction with other ecological factors limits Canada violet populations in the Maritimes.

One additional patch of Canada violet was noted during the 2003 survey just south of the rich hardwood stand located north of Demerchant Brook however this patch is located approximately 50 m upslope of the proposed TCH route (Figure 5.5.1-A, Appendix D).

Calypso or Venus' Slipper (*Calypso bulbosa*)

Calypso is a diminutive orchid that in flower (mid-May to mid-June) vaguely resembles a small pink lady's-slipper bloom, and has a single, small, shiny round-ovate leaf with prominent veins reminiscent of a lady's-slipper orchid or a plantain leaf.

Hinds (2000) relates that calypso, in New Brunswick (the only Maritime Province portion of its extensive world wide range), occurs primarily in old growth, calcareous, eastern white cedar (*Thuja occidentalis*) forest, in shaded conditions. Calypso is apparently intolerant of too much competition from other small herbaceous species and in these wet forests grows out of moss or thick duff often near the base of cedar trees. The species has also occasionally been recorded from calcareous old growth deciduous forest but again in relation to a thick mossy carpet. Common elements for calypso habitat appear to be mature, shaded, and mesic, calcareous habitats with plenty of moss. Given that old growth calcareous forests are becoming scarce in New Brunswick and mature cedar stands are frequently cut down for cedar shingles and shakes, in addition to occasionally being flooded by beaver activities, it is little wonder that this orchid is scarce in the province.

The ACCDC (2003) classes the species as S2. NBDNRE (2002a) places calypso in the "May Be At Risk" category. Populations of calypso are known from two ESAs in the area: Clark Brook Bog and Ketch Lake.

Calypso was located at only one site (Figure 5.5.1-D, Appendix D, and Figure 5.5.10). Hinds (2000) noted "...only a few plants occurring at any extant location " and indeed this was the case in the white cedar dominated mesic forest where the species was detected. A single calypso plant was found in full bloom, on the current eastbound lane cut line and a single flowering plant and three non-flowering plants 50 m outside the current Project footprint, moved to create this 50 m buffer. Other orchid species found in the same general habitat and site location include yellow lady's-slipper (*Cypripedium parviflorum* var. *pubescens*), Hooker's orchid (*Platanthera hookeri*), and heartleaf twayblade (*Listera cordata*). Calypso plants here were found growing from dense, raised moss hummocks with sparsely



growing associate vascular plants such as bunchberry (*Cornus canadensis*), swamp red raspberry (*Rubus pubescens*) and naked mitrewort (*Mitella nuda*).

Mountain Valerian (*Valeriana uliginosa*)

Mountain valerian has been recorded at a number of locations in New Brunswick mostly on the western edge of the province along the St. John River valley and rivers draining into it. NBDNRE (2002a) lists mountain valerian as "May Be At Risk". It is listed as S2 by ACCDC (2003). Mountain valerian is generally associated with calcareous swamps and fens.

Mountain valerian was found at one location during the July 2003 field survey on the banks of Big Presque Isle Stream (Figure 5.5.1-C, Appendix D). Four small patches of mountain valerian were present approximately 80 m east of the westbound centreline of the highway. The four patches of mountain valerian were all found on a steep stream bank near the high water mark. The plants were associated with shallow soil deposits at the base of bedrock outcrops. These areas are kept moist by groundwater seepage from the base of the steep slope of the ravine through which the river flows. Mountain valerian was associated with introduced species such as garden loosestrife (*Lysimachia vulgaris*) and creeping bellflower (*Campanula rapunculoides*) and native species such as marsh-marigold (*Caltha palustris*) and fen grass-of-Parnassus (*Parnassia glauca*).

5.5.4.3.2 "Sensitive" Species

Hooked Agrimony (*Agrimonia gryposepela*)

Hooked agrimony is currently listed as S2 by the ACCDC (2003), and is considered "Sensitive" by NBDNRE (2002a). In the Maritimes, hooked agrimony is found in thickets, intervalles, slopes, and the margins of rich woods (Roland 1998), and in rich woods and thickets (Hinds 2000). Hinds (2000) considered the species uncommon (S3). Its precise status is somewhat unclear due to its close similarity to the much more common roadside agrimony (*A. striata*), and it likely belongs in the S3 category (S. Blaney, pers. comm. 2002). The apparent rareness of hooked agrimony may be due to it being passed by as an example of the more common species. It is likely hooked agrimony is more rare along the proposed TCH route than *A. striata*, due to its requirement for more calcium rich soils.

In 2002, no precise locations for the plant were determined. The identification of hooked agrimony came from a piece of stem bearing leaves and relatively early fruit that was collected for later identification. In 2003, hooked agrimony was identified at two locations, both on the westbound lane centreline (Figure 5.5.1-A, Appendix D, and Figure 5.5.5). Although only two locations of this species were recorded, it is the opinion of the surveyors that a viable population of hooked agrimony is located outside the Project footprint.



Boreal Bog Sedge (*Carex magellanica* ssp. *magellanica*)

Boreal bog sedge is associated with sphagnum bogs (Hinds 2000). This species is listed as S2 ACCDC (2003), and is considered "Sensitive" (NBDNRE 2002a). Boreal bog sedge was found at one location along the proposed TCH route (Figure 5.5.1-C, Appendix D), in Wetland 18 scattered in the swamp portion near the bog edge. The Project footprint will avoid this area of the wetland.

Plantain-leaved Sedge (*Carex plantaginea*)

Plantain-leaved sedge is associated with rich or calcareous hardwoods primarily in Carleton County (Hinds 2000; MacDougall and Loo 1998). This species is listed as S2 (ACCDC 2003) and "Sensitive" (NBDNRE 2002a). It can be considered a legitimately rare species restricted to Carleton and Victoria counties in the Maritimes, with the exception of one record near Truro in NS (S. Blaney, pers. comm. 2002).

Plantain-leaved sedge was recorded in three rich mature hardwood slope sites encountered along the route in 2002 by JWEL (Figure 5.5.1-A, Appendix D, and Figures 5.5.2, 5.5.3, and 5.5.4). It was typically found in tolerant hardwood forest dominated mainly by sugar maple, American ash, butternut and ironwood. Sites hosting plantain-leaved sedge were relatively mesic and evidently nutrient and calcium rich. It tended to occur along intermittent watercourses and surface flow channels in the woods and at drier sections of seep sites. At the rich hardwood stand south of Beaconsfield Road it was also found within a regenerating clear-cut. Common herbaceous associates included Goldie's fern, wild ginger, blood root, northern maidenhair-fern, silvery spleenwort, smooth yellow violet, and at some sites blue cohosh.

At the rich hardwood stand south of Beaconsfield Road (Figure 5.5.2), plantain-leaved sedge was noted at 10 locations and along an 80 m stretch of the rich habitat, totaling an estimated 470 plants. At the rich hardwood site north of Demerchant Brook (Figure 5.5.3) that also contains the Canada violet, the sedge was found within 36 patches in two distinct areas, totaling approximately 1,000 rosettes. The rich hardwood stand north of Bryson Brook (Figure 5.5.4) contained an estimated 160 plants found within 6 patches.

All three sites where this species was noted by JWEL will be avoided due to re-routing. The two sites where ACER (2003) reported finding this species were revisited in 2003. The plants near an old bush road north of Upper Guisguet Brook (Figure 5.5.7) were not relocated, however other species were noted at this site, including Goldie's Fern. Three patches were found approximately 500 m south of Stairs Road (Figure 5.5.8), including a large patch 2 m in diameter.

During other follow-up surveys in 2003, plantain-leaved sedge was noted at three additional locations, including near the nodding fescue site (Figure 5.5.1-B, Appendix D, and Figure 5.5.6), which is outside the Project footprint, and two separate areas south of Dean Road (Figure 5.5.1-A, Appendix D) within and one outside the Project footprint, in the flood plain of McMullin Brook. Overall, five of the plantain-leaved sedge sites are located outside the Project footprint.

Sprengel's Sedge (*Carex sprengelii*)

Sprengel's sedge has been recorded mainly in Carleton County with outlying records in Sussex, Doaktown, near Fredericton, on the Restigouche River and in Victoria County. Sprengel's sedge is listed as S2 (ACCDC 2003) and is considered "Sensitive" (NBDNRE 2002a). This species is associated with rich alluvial hardwood forests as well as calcareous slopes and banks. One small patch of Sprengel's sedge was recorded in 2003 near the Canada violet site (Figure 5.5.1-A, Appendix D, and Figure 5.5.3). It was situated high on the banks of an intermittent stream which drains the Canada violet site. This patch is located just outside of the proposed Project footprint.

Showy Lady's-slipper (*Cypripedium reginae*)

In New Brunswick, showy lady's-slipper is characterized as very rare (S2) by Hinds (2000), as S2 by the ACCDC (2002a), and as "Sensitive" by NBDNRE (2002a).

Showy lady's-slipper habitat is alkaline swamps or bogs (Roland 1998). Hinds (2000) characterizes the habitat as calcareous bogs, fens and edges of Eastern White Cedar swamps. While, mature plants appear to do fine in more open sunlight they are often found in some degree of shade. The basic microhabitat they occupy is moist but not overly so and where water level fluctuations in the soil are not extreme. The common plant associates suggest soil that is moist, and with an unusual mix of acidity and alkalinity. Showy lady's-slipper might be expected within a situation where sphagnum moss and other bog type plants characteristic of acidic sites (*i.e.*, black spruce (*Picea mariana*), bunchberry (*Cornus canadensis*), and mountain holly (*Nemopanthus mucronata*)) grow with plants indicative of more alkaline conditions (*i.e.*, Red Osier (*Cornus sericea*), water avens (*Geum rivale*) and eastern white cedar (*Thuja occidentalis*)). The underlying calcium rich situation may result from calcium rich substrate or calcium particle deposition moving in via water flows from adjacent areas. Hinds (2000) characterization of the showy lady's-slipper occurring at the edge of calcareous Cedar swamps may relate to the greater alkalinity along the edge of such sites from surface and ground water coming in off adjacent uplands.

Showy lady's-slipper in full growth and bloom is unmistakable. Non flowering plants may have a superficial resemblance to Hellebore (*Veratrum viride*), but the two species are not commonly found together. Younger specimens of showy lady's-slipper, at some seasons of growth may resemble the



smaller yellow lady's-slipper, which may occur in the same habitat. Generally the much larger *C. reginae* emerges above ground and flowers later than yellow lady's-slipper in any given general location. The plants identified during the June 10, 2003 survey date were only emerged to some 15 cm and the leaves were yet to unfurl and in a cylindrical shape. The few yellow lady's-slipper encountered in or near this location were far advanced growth wise.

Showy lady's-slipper sites within or immediately adjacent to the Project footprint were detected only in an eastern white cedar stand north of Little Presque Isle Stream (Figure 5.5.1-D, Appendix D, and Figure 5.5.9) near the proposed Hartland Interchange. A diffuse population of 20 plants was reported within the Project footprint by Dillon (2003) in 2002, however this population was not relocated in 2003. Some 10 clumps totaling 37 stems were located in the area during the follow-up survey by JWEL in June 2003. Two clumps of 16 stems are located approximately 15 to 20 m from the realigned Project footprint. The remaining eight clumps are located approximately 75 m from the Project footprint. Plants were mostly growing relatively near an upland edge to the cedar stand. The plants recorded in 2002 are all located inside the Project footprint. Incidentally, an individual stem of *C. reginae* was found at the edge of a wetland just off Wilmot Road near Strong Corner, approximately 900 m west of the Project footprint (Figure 5.5.1-C, Appendix D).

Goldie's Fern (*Dryopteris goldiana*)

Goldie's fern is typically found under heavy shade in hardwood stands on very rich circumneutral soils. It is not rare nationally (COSEWIC 2003), however, Hinds (2000) considered it to be very rare in New Brunswick. The ACCDC (2003) lists it as a rare species (S2). NBDNRE (2002a) considers the species to be "Sensitive". In addition to the recorded locations of Goldie's fern in New Brunswick, this species has recently been found growing near the mouth of the Pokiok River.

In 2002, Goldie's fern was found in two main habitat types, both associated with mature, or recently clear-cut hardwood forests dominated by sugar maple, American ash, black ash, and butternut. The typical sites occurred within and near the margins of intermittent streams or surface water flow areas that were not overly moist in late summer. The soils at these sites could be described as alluvial in nature and very rich. Typical herbaceous associates included wood nettle, and silvery spleenwort fern, along with plantain-leaved sedge, blood root, wild ginger, and Dutchman's breeches. In the same habitat, but generally disjunct from the Goldie's fern colonies, were typically found northern maidenhair-fern and yellow lady's-slipper. In one instance nearby patches of Canada violet and scattered blue cohosh were found.

The second habitat type is associated with mesic areas along seepage tracks. The hardwood forest at this habitat type is similar to that of the first type except that American beech was relatively abundant.



In general, Goldie's fern would be expected to occur in areas of mature tolerant hardwood species dominated by species favouring more mesic sites such as sugar maple, ash, butternut and ironwood. An increased dominance of beech in the forest did not appear to predict this fern's presence. Goldie's fern populations would be expected where seasonal stream or surface water courses were present or where not overly wet subsurface seepage enriched the local soil and decreased soil acidity.

Goldie's fern was one of the most abundant of the rare vascular plants at the three rich areas identified by JWEL in 2002 (Figure 5.5.1-A, Appendix D, and Figures 5.5.2, 5.5.3, and 5.5.4), occupying large areas. These three areas will now be avoided, given the re-routing around these areas. Outside of these three rich habitats, Goldie's fern was recorded at three locations associated with Browns Brook, all outside (east) of the Project footprint (Figure 5.5.1-A, Appendix D). The populations at these locations are small relative to the rich sites, occurring in a large patch or several scattered patches.

ACER (2003) also reported Goldie's fern, approximately 380 m north of Upper Guisguet Brook (Figure 5.5.1-B, Appendix D). This site was revisited in 2003, and the locations of this species are shown in Figure 5.5.7, both inside and outside the Project footprint. Goldie's fern was also noted in several more areas in 2003, including: the nodding fescue site (Figure 5.5.1-A, Appendix D, and Figure 5.5.2); the largest patch (approximately 150 m X 70 m) noted to date, 75 m east of the Project footprint near Brown Brook (Figure 5.5.1-A, Appendix D); south of Dean Road in a 15-year old clear-cut inside the Project footprint (Figure 5.5.1-A, Appendix D, and Figure 5.5.5); south of Route 560 and River de Chute, outside of the Project footprint (Figure 5.5.1-B, Appendix D, and Figure 5.5.6); and in a hardwood ravine south of Stairs Road at the edge of the Project footprint (Figure 5.5.1-B, Appendix D, and Figure 5.5.8).

Lopseed (*Phryma leptostachya*)

Lopseed is an S2 species (ACCDC 2003) that is considered "Sensitive" (NBDNRE 2002a). Hinds (2000) reports that in New Brunswick lopseed is found in rich hardwoods and in the presence of butternut trees. Within the Maritime Provinces, lopseed is restricted to the very richest forest sites in western New Brunswick (S. Blaney, pers. comm. 2002). The New Brunswick population is substantially disjunct from the nearest populations in Quebec and New Hampshire (the species is extirpated from Maine).

In 2002, JWEL encountered lopseed at the rich hardwood stand located north of Demerchant Brook (Figure 5.5.1-A, Appendix D, and Figure 5.5.3), which is now avoided by proposed TCH route (JWEL 2003a). Lopseed was found growing in four discrete clumps, containing clusters of 40, 25 and three stems, and as a single stem, all within a 100 m radius. The site on which it was growing was an evidently calcium-rich, mature hardwood slope. This forest stand was dominated by mature sugar maple, butternut, American ash and ironwood. Scattered beaked hazelnut and occasional red elderberry



and mountain maple were present in the shrub layer. Ground vegetation layer associates were plantain-leaved sedge, bloodroot, zigzag goldenrod, wild ginger, silvery spleenwort, smooth yellow violet, and great burdock, an invasive exotic species. This section of rich slope hosting the lopseed was largely free of Goldie's fern and Canada violet that grew 50 m to the north. Browse damage likely attributable to deer or moose was apparent in some of the clumps examined and such predation may limit this species, though several of the stems had successfully set seed.

Lopseed was discovered by ACER (2003) at another site in a hardwood ravine south of Stairs Road (Figure 5.5.1-B, Appendix D, and Figure 5.5.8). A follow-up survey was conducted by JWEL in 2003 in this area, at the request of NBDNR. Lopseed was noted in four clusters totaling 12 stems near some maidenhair-fern, and two clusters totaling 7 stems were present adjacent to a large clump of plantain-leaved sedge, in a rich stream area that had been clear cut only 2-3 years earlier. At this location weedy early successional species were competing with remnant, rich hardwood ground flora that included plentiful maidenhair-fern, some plantain-leaved sedge and a few small clumps of Goldie's fern. Lopseed was also detected on two small, rich alluvial ledges along a presently deep cut, intermittent flow stream gully through rich deciduous forest and mixed forest. Here, lopseed populations consisting of 11 clumps and 50 stems, and 7 clumps and 21 stems respectively, noted under shady conditions with associated flora not dissimilar to that described above except for fewer butternut. Despite investigating the feasibility of adjusting the alignment to avoid or minimize the area of disturbance of this site, NBDOT was unable to move the alignment, predominantly due to watercourses in this area. Also, during the early stages of the project during regulatory review of corridor options, DFO recommended that the alignment should be located between the two tributaries of the Lower Guisguet River.

Historic (within the last six years) records of lopseed indicate that at least four additional lopseed sites are located within the Assessment Area (S. Blaney, pers. comm. 2002). These locations include two recorded by the NTNBN within two Appalachian Hardwood Forest stands in 1997, within 4 km of the Stairs Road site. The four historic lopseed sites are located outside the Project footprint.

Canada Clearweed (*Pilea pumila*)

Canada clearweed is generally found growing in alluvial woods and other moist, shaded areas. In New Brunswick it was previously only found in the Saint John River valley in York and Carleton Counties (ACCDC 2002). It is locally abundant along the river in seasonally flooded forest, and less common in seepage areas and along small watercourses away from the river. Hinds (2000) describes clearweed as occupying alluvial woods and other moist shady areas and considered clearweed to be very rare in New Brunswick. The ACCDC (2003) lists it as S2 and it is considered "Sensitive" by NBDNRE (2002a). It occurs in Prince Edward Island and Nova Scotia, and could be found in other counties in New Brunswick (S. Blaney, pers. comm. 2002).



Canada clearweed is an annual species. It is a small plant that rarely exceeds 20 cm in height in the Maritime Provinces (though it may grow to 50 cm further south). In less favourable conditions, or where populations are dense, fruiting individuals may be only 5-10 cm tall. The species gets its name from its water-filled, translucent stems. In this species turgor pressure is the primary means of keeping the plant erect. This adaptation probably reduces the amount of resources required to maintain the plant's structure. This adaptation restricts clearweed to habitats that are continuously moist. In more southern climates it is widespread, secure and able to take advantage of a wide range of habitats.

Canada clearweed is found in continuously moist, nutrient-rich, often shaded sites with limited competition from taller plants. The plant tends to be most abundant in vernal pools or shorelines within swamp forest, where seasonal flooding limits the growth of other species. In New Brunswick it is often associated with silver maple floodplain forest, while elsewhere in the Maritimes it may be found in muddy areas along alder-lined streams, or within mixed-forest swamps or deciduous forest where groundwater seeps to the surface (ACCDC 2002).

Within the Project survey areas this annual species was mostly found in shallow, possibly sinkhole-derived, marshy basins. The basins were dominated by herbaceous species, mainly sensitive fern, along with lesser quantities of common skullcap, mad dog skullcap, common mint, and sedges. Red osier dogwood typically occurred in patches along the edges of these wet basins, along with the occasional willow and tree species. Scattered shallow ephemeral pools occurred within these basins, especially towards the margins. In all habitats in the area matching this description Canada clearweed proved to be present except for one very small example that had only two small pool areas suitable for Canada clearweed.

In such wet basins, Canada clearweed occupied a microhabitat best described as relatively open, dry pool areas where the substrate was not occupied by competing plants, and moisture was abundant. Some plants were also noted to occur on mossy logs above these open pool areas where moisture wicked up from the ground. Canada clearweed appears to be able to germinate later in the season with the water draw down and thus gain a niche relatively free of competition with the dominant perennial herbs. While some shading was present from adjacent forest trees, many of the plants here would be subject to long hours of full sunlight. Canada clearweed was a relatively minor floral component of the habitats occupied.

The sensitive fern basins were relatively easy to distinguish on aerial photographs, and basins outside of the Project footprint were visited following the initial plant survey. As noted above, most were shown to host clearweed populations. Canada clearweed was also found to occur in sections of intermittent streams, in patches of rich hardwood forest dominated by sugar maple, butternut, American ash and black ash, and along woods roads. The ephemeral streams or drainage swales provided rich soil and a shady, moist, seepy microhabitat within the forest. These sites supported rare flora like Goldie's fern,

and northern maidenhair-fern, as well as the more common perennial relative of clearweed, wood-nettle. Here clearweed occurred in small numbers in more open patches amid or at the edge of the larger perennials. The individual specimens were frequently more robust than those in the sensitive fern basin wetlands where soils were perhaps more acidic, germination may have occurred later and crowding of the Canada clearweed plants was more pronounced. At one of the rich sites a small population of Canada clearweed was found growing along a woods road. This population was found on disturbed mineral soil that had a moist aspect, as if lightly suffused by seepage. Again the plant appeared to demonstrate the need for a nutrient rich non-acidic, reliably moist site in which a regime of periodic disturbance kept patches of habitat free from occupancy by perennial species.

In 2002, Canada clearweed was recorded at 17 locations between Perth-Andover and River de Chute (Figure 5.5.1-A, Appendix D), including two of the rich sites (Figure 5.5.1-B, Appendix D, and Figures 5.5.2 and 5.5.3), which contained three of the locations. In addition to these records, this species was only noted south of River de Chute in 2003 near an old woods road approximately 250 m north of Upper Guisiguit Brook (Figure 5.5.1-B, Appendix D, and Figure 5.5.7), and near Big Presque Isle Stream between the proposed TCH route and Access Road "J" (Figure 5.5.1-C, Appendix D). An estimated 15 % of the plants are located within the proposed Project footprint. At the rich site south of Beaconsfield Road, one location is within the re-routed Project footprint (Figure 5.5.1-A, Appendix D), and another is located approximately 200 m downstream of the Project footprint (Figure 5.5.2). At the rich hardwood stand north of Demerchant Brook (Figure 5.5.3), the plants are avoided by the new re-route. The largest populations appeared to be at Wetland 7 and Wetland 8 (Figure 5.6.1-A, Appendix E); of these populations, only a portion of the Canada clearweed plants scattered at the edges of Wetland 8 are expected to be directly affected by the Project footprint. It would likely be difficult to avoid this wetland altogether, as McMullin Brook is located parallel to the proposed TCH route to the west. The re-route near Wetland 7 (south of Graham Brook) places the wetland just west instead of just east of the Project footprint. Of the 13 remaining locations, which were mostly the basin habitats described above, only two small sites, near Bishop Lake (Figure 5.5.1-A, Appendix D) and north of Upper Guisiguit Brook (Figure 5.5.7) are located within the Project footprint.

Lesser Bladderwort (*Utricularia minor*)

Lesser bladderwort is ranked S2 (ACCDC 2003) and is considered "Sensitive" (NBDNRE 2002a). Lesser bladderwort has been recorded from shallow pools and boggy meadows in New Brunswick (Hinds 2000). It is an aquatic species that has probably been overlooked as much as it is rare (S. Blaney, pers. comm. 2002). It is likely present throughout the province in both acidic and basic areas (but probably more common in acidic areas). In addition to available records, ACCDC has a number of probable specimens requiring confirmation (S. Blaney, pers. comm. 2002).



Lesser bladderwort was encountered by JWEL (2003a) in Wetland 3, near the edge of the proposed Project footprint (Figure 5.5.1-A, Appendix D). At this site, the lesser bladderwort occurred within an alder and drowned white cedar swamp wetland present at the margins of a dammed pond, which is part of a larger wetland complex. The wetland element hosting this bladderwort was characterized by scattered drowned white cedar, with higher hummocks occupied by speckled alder (*Alnus incana*) and sedge, alternating with a reticulate network of water filled channels and sloughs supporting a variety of aquatic and semi-aquatic plant species. In the habitat where the lesser bladderwort was found, common associates were nodding beggar-ticks (*Bidens cernua*), small-fruited burreed (*Sparganium natans*), and wild calla (*Calla palustris*). Reddish pondweed (*Potamogeton alpinus*), and variable pondweed (*P. graminus*) were also present in deeper waters. In shallower sloughs and edges several colonies of small yellow water-crowfoot (*Ranunculus gemilini*) were encountered (outside of the Project footprint). Lesser bladderwort was present in the shallows mixed in with the other aquatic species.

Bladderworts, especially those with reduced foliage, are generally rather cryptic as they tend to blend in with the other vegetation or substrates of their habitat. As such, they can be often overlooked except for the more robust species, and are most noticeable when in flower. Given the size of the wetland (6.7 ha) and the nature of this species, and since site conditions (*i.e.*, unstable footing) did not permit a survey of all suitable habitats in the wetland that may have contained this species, lesser bladderwort is likely present elsewhere in the wetland complex.

ACER (2003) also recorded the presence of lesser bladderwort in Wetland 11 (Figure 5.5.1-B, Appendix D). At this site, the lesser bladderwort occurred within a beaver pond, upstream of the Project footprint. Two other uncommon species were recorded in this wetland: lesser tussock sedge and hidden-scaled sedge.

Northern Maidenhair-fern (*Adiantum pedatum*)

Northern maidenhair-fern is an S2 species (ACCDC 2003) considered "Sensitive" (NBDNRE 2002a). In New Brunswick the habitat of northern maidenhair-fern is in rich hardwood forests associated with circumneutral soils (Hinds 2000). It is restricted to rich soiled forests, primarily in western New Brunswick but is somewhat more widespread and tolerant than Goldie's fern or lopseed. While a few widely scattered records occur elsewhere in the province the bulk of records come from the rich Saint John River Valley Hardwood Forest assemblage in Carleton and southern Victoria counties (MacDougall and Loo 1998). Northern maidenhair-fern was probably fairly common historically within western New Brunswick, but it is now greatly reduced from pre-settlement numbers due to agriculture and forestry. It is also found in Nova Scotia, but is almost extirpated there (there is one known small population).



In 2002, northern maidenhair-fern was recorded by JWEL (2003a) within the three rich areas (Figure 5.5.1-A, Appendix D, and Figures 5.5.2, 5.5.3, and 5.5.4), as well as four other locations (Figure 5.5.1-A, Appendix D). Northern maidenhair-fern may possibly accept a broader range of soil richness or acidity levels than other of the rare hardwood associated flora in the area, as it was about as widely encountered as yellow lady's-slipper. This fern predominantly occurred in association with mature hardwood forests. Forests hosting northern maidenhair-fern were dominated by sugar maple, American ash, black ash, butternut and other tolerant hardwoods. This fern was most common along the edges of intermittent streams, and the largest population of northern maidenhair-fern noted was present along the rich hardwood stand south of Beaconsfield Road (Figure 5.5.2). At this location Goldie's fern and plantain-leaved sedge were notable associates. Northern maidenhair-fern was also present on rich hardwood forest slopes where moist seepage enriched the soil. Here northern maidenhair-fern occurred at the dryer periphery often close to clumps of Goldie's fern and plantain-leaved sedge. Northern maidenhair-fern was also encountered in some instances in regenerating clear-cuts.

Both ACER (2003) and Dillon (2003) reported northern maidenhair-fern. These sites included just south of Route 560 (Figure 5.5.1-B, Appendix D, and Figure 5.5.6), which is now avoided; north of Upper Guisguitt Brook (Figure 5.5.1-B, Appendix D, and Figure 5.5.7); south of Stairs Road (Figure 5.5.1-B, Appendix D, and Figure 5.5.7); an area just south of Big Presque Isle Stream now avoided due to realignment (Figure 5.5.1-C, Appendix D); and an area north of Palmer Road (Figure 5.5.1-D, Appendix D).

In 2003, this species was recorded at 48 locations in 7 general areas, with some sites inside and some outside the Project footprint. In total, this species was noted in 11 general areas in the area surveyed (ten north of Dryer Road), of which a viable population will remain in eight of these. In general, as appears to be the case for yellow lady's-slipper, northern maidenhair-fern was one of the more widely distributed of the "Sensitive" class plants and yet was generally patchy in distribution and always associated with richer sites and microhabitats.

Lance-leaved Grapefern (*Botrychium lanceolatum* var. *angustisegmentum*)

Lance-leaved grapefern is an S3 species (ACDC 2003) that is considered "Sensitive" (NBDNRE 2002a). Although an uncommon species, it is fairly widespread, tending to be found in richer soiled areas in both deciduous forest and cedar swamp (S. Blaney, pers. comm. 2002). The habitat for lance-leaved grapefern is described as dry to moist open woods and rich deciduous forest (MacDougall and Loo 1998), as well as clearings adjacent to rich hardwoods (Hinds 2000), and rich, wooded hillsides (Roland 1998). It is an erect perennial herb up to 20 cm tall with a single pinnate frond.

One specimen of lance-leaved grapefern was encountered at a single site north of Plant Brook (Figure 5.5.1-A, Appendix D) along a rich slope within a hardwood stand dominated by young white birch and



trembling aspen. This stand was approximately 15 years old. Bunchberry was the dominant ground vegetation in the vicinity of the single grapefern noted. Despite a directed search in the area of the initial sighting no further specimens were encountered. No further lance-leaved grapeferns were encountered anywhere else along the route nor were any other grapefern species found, including the large and relatively common rattlesnake fern (*Botrychium virginianum*). This specimen of lance-leaved grapefern was recorded approximately 35 m outside of the realigned Project footprint.

In general grapeferns are characteristic of richer sites and tend to occur as single plants or small often-diffuse groups within a particular area where they are discovered. While many species of grapeferns are rather small and cryptic this aspect alone does not explain their apparent rarity, especially since other diminutive and cryptic taxa are much more frequently encountered. As ferns, their spores presumably give them great dispersal potential but their requirements for gametophyte generation, growth and subsequent sporophyte generation formation are either very precise and/or infrequent, or other ecological factors limit their presence in the landscape. It does not spread vegetatively by rhizomes. In general the presence of lance-leaved grapefern, in addition to several other rare species of *Botrychium*, often correlates to rich hardwood stands. However lance-leaved grapefern is also found in open habitat in northern areas (NatureServe 2002).

Yellow lady's-slipper (*Cypripedium parviflorum* var. *pubescens*)

Yellow lady's-slipper is an S3 species (ACCDC 2003) that is found in richer soils in most of the areas where it occurs in the province. However, it is a fairly common species in northwestern New Brunswick, and uncommon but dependably present in northeastern and southwestern older growth woods and cedar swamps, usually in lime rich soils (Hinds 2000; S. Blaney, pers. comm. 2002). The total number of known sites in New Brunswick probably exceeds 50. Nonetheless, the species is considered "Sensitive" (NBDNRE 2002a). This species is threatened by picking of flowers and digging of roots (presumably for gardens) and by habitat loss within parts of its range. This species is considered rare in Prince Edward Island and Nova Scotia.

This variety of yellow lady's-slipper is a colony-forming species (*i.e.*, forms clonal patches). Although there may be many thousand populations of this species throughout its extensive range across Canada and the United States, most populations are small. There are very few reports of large, secure populations anywhere in North America (NatureServe 2002). All reported populations contain less than 400 individuals, and most contain less than 30 (NatureServe 2002).

In 2002, yellow lady's-slipper was encountered in greatest numbers in the two rich mature deciduous forest stands (Figure 5.5.1-A, Appendix D, and Figures 5.5.3 and 5.5.4) dominated by sugar maple, American ash, and butternut. In this habitat the greatest number of clumps were found and the largest number of stems per clump were noted. This species was most abundant in the more southerly stand,



where approximately 275 individuals were noted in 39 clumps. The species often occurred to some extent within and near the richest moist (not wet) seepage sites that commonly hosted species such as Goldie's fern, plantain-leaved sedge, and northern maidenhair-fern. These plants are located outside the Project footprint.

Additional sightings in 2002 by JWEL (2003a) included a recent clear-cut in once mature forest, in thickets near a less rich stream site (20 plants), at the edge of a sensitive fern basin marsh (18 plants in 4 clumps), amid some mature white cedar (7 plants in 2 clumps) and at the edge of Wetland 3, outside the Project footprint (Figure 5.5.1-A, Appendix D). Dillon (2003) reported one record of a single specimen in 2002 (Figure 5.5.1-D, Appendix D), however the proposed TCH has been re-routed, and this site is now avoided.

In total, yellow lady's-slipper was recorded at 66 locations in 16 general areas, with 11 areas containing plants outside the Project footprint. In general it was one of the more widely distributed of the "Sensitive" class plants and yet was patchy in distribution and always associated with richer sites and microhabitats.

Braun's Holly Fern (*Polystichum braunii*)

Braun's holly fern has been recorded at least 33 locations in New Brunswick (Hinds 2000). Most records are from northern, western and southern portions of the province. Braun's holly fern is listed as an S3 species (ACCDC 2003) and is considered "Sensitive" (NBDNRE 2002a). In the Maritimes, this lacy, dark green holly fern is generally found in rich woods, primarily on calcareous soils (Hinds 2000). Similarly, Roland (1998) describes the preferred habitat for this species as deciduous forests, ravines and scapy hillsides. In contrast to the more generally distributed (in New Brunswick) and more southern ranging Christmas fern (*P. acrostichoides*), Braun's holly fern is less able to tolerate head and drought than Christmas fern. This need cooler and moister conditions than required by Christmas fern likely explains the fact that Braun's holly fern encountered during surveys for the Project were located along streams and seeps shaded by mature forest.

Braun's holly fern was found at two locations in 2003. One site was located just south of the rich hardwood stand south of Beaconsfield Road (Figure 5.5.1-A, Appendix D, and Figure 5.5.2) and the second was found south of Backland Road (Figure 5.5.1-B, Appendix D). Both records consisted of single plants growing on the fertile banks of intermittent streams. At the site near the rich hardwood stand south of Beaconsfield Road, Braun's holly fern was associated with several rare species including nodding fescue, pale touch-me-not, Goldie's fern, and plantain-leaved sedge. This location is approximately 40 m outside of the Project footprint. At the second site south of Backland Road no other rare or uncommon species were noted. This one plant was found on the westbound lane cutline, within a mature cedar stand.



Historic records of Braun's holly fern indicate that at least five additional sites are located within the Assessment Area (Hinds 2000). These five recorded Braun's holly fern sites are located outside the footprint of the Project.

5.5.4.3.3 "Secure" Species

Small Yellow Water-crowfoot (*Ranunculus gmelinii* var. *purshii*)

Small yellow water-crowfoot is currently ranked S2 (ACCDC 2003), but is considered "secure" (NBDNRE 2002a). It is an aquatic species that is fairly rare in New Brunswick, occurring in neutral to basic (lime rich) pools and still waters essentially throughout the province. It is an uncommon species in both Nova Scotia and Prince Edward Island as well. More records can be expected in New Brunswick and in the future it may well be ranked S3 (S. Blaney, pers. comm. 2002).

This species was recorded at five locations (Figure 5.5.1-A, Appendix D), including open water habitat at Wetland 3, in Wetland 2, in a small pond 300 m east of Wetland 2, and two locations along McMullin Brook to the west of Wetland 8. It covered a 4 m² area of open water in Wetland 3, located approximately 100 m west of the proposed TCH route, and was abundant in the other three locations. In Wetland 2 this species accounted for approximately 5 percent of the vegetation cover. Wetland 2 is bisected by the eastbound lane centreline, and would therefore be directly affected by construction activity.

Clammy-Hedge-Hyssop (*Gratiola neglecta*)

Clammy-hedge-hyssop is a small yellow and white flowered annual that is able to persist in very particular ruderal (disturbed) habitats. Such habitats appear to consistently offer an open sunny, wet muddy substrate which initially at least has a very shallow cover of water, and that never completely dries out. Few perennial competing plants are immediately present to prevent successful germination and growth. Additionally the substrate may be somewhat less acidic than that tolerated by the related perennial, and in N.B. even rarer, golden pert (*G. aurea*). Hinds (2000) describes clammy-hedge-hyssop habitat as muddy shores and in shallow water, and classes the species as extremely rare or S1. Recent clammy-hedge-hyssop population records by the ACCDC, and others, and records along the proposed Pokiok to Longs Creek section of the TCH have supported the classing of clammy-hedge-hyssop by ACCDC as S2/S3, and the NBDNRE (2002a) classification of "Secure".

It is apparent that the species has also found a niche along infrequently used wood roads where conditions of soil type and moisture retention and the creation of rut pools favour it. The plants are able to establish populations and persist where trucks have created shallow rut pools. This is in part due to persistent water and moisture retention, and in part due to infrequent vehicle passage not encouraging or



excluding competing perennial plants establishing. Infrequent vehicle passage is less deleterious, particularly in the seed stage, to an annual species than a perennial. The trucks may even help disperse seed to suitable rut pools up and down the road after initial successful colonization of the road and may also be a significant disperser of clammy-hedge-hyssop from more distant sites. Very frequent passage of vehicles would diminish or extirpate populations in this habitat type.

In the rerouting south of the Dryer Road (Figure 5.5.1-C, Appendix D), four populations of clammy-hedge-hyssop were found in 2003 growing along three infrequently utilized wood roads in habitat situations as described above. The populations comprise estimates of 5, 30, 50 and 100 plants mostly within the Project footprint, however, a viable population is present outside of the footprint.

Small-fruited Burreed (*Sparganium natans*)

Small-fruited burreed is a borderline S2S3 species (ACCDC 2003) which is considered "Secure" (NBDNRE 2002a). Small-fruited burreed is an aquatic species found in alkaline ponds and lagoons, and on pond margins (Hinds 2000).

In the Assessment Area small-fruited burreed was encountered from only one site, in Wetland 3, at the same location as lesser bladderwort was found (Figure 5.5.1-A, Appendix D). The small-fruited burreed occurred within an alder swamp present at the margins of a beaver-flooded pond. The abundance of this species at this location was estimated at 150 plants. As with the lesser bladderwort, small-fruited burreed may be present elsewhere in the wetland complex.

Blue Cohosh (*Caulophyllum thalictroides*)

Blue cohosh is typically found in scattered localities in New Brunswick in rich, circumneutral soils of deciduous woods and alluvial bottomlands. It is not rare nationally, and NBDNRE (2002a) has listed the species as "Secure". The ACCDC (2003) lists this species as uncommon (S3). This is a perennial herbaceous plant with a smooth purple stem, which can reach 80 cm in height. It is a species of rich soil, occurring in upland forests in Carleton and Victoria counties, but is essentially restricted to floodplains elsewhere. It is most common within the Saint John drainage, where it can be consistently found in suitable habitat (S. Blaney, pers. comm. 2002). Recent work has shown it to be more common in the Miramichi system and northwestern New Brunswick than had been previously known. The total number of locations in the province likely exceeds 50 (S. Blaney, pers. comm. 2002).

Blue cohosh was recorded by JWEL (2003a) in 2002 at least four locations, including two rich hardwood stands (Figure 5.5.1-A, Appendix D, and Figures 5.5.3 and 5.5.4). Outside of these rich areas blue cohosh was found just south of Wetland 8 within the westbound lane (Figure 5.5.1-A, Appendix D, and Figure 5.5.5), and associated with Goldie's fern east of the proposed TCH route on Brown Brook



(Figure 5.5.1-A, Appendix D). Dillon (2003) also recorded blue cohosh in an area now avoided due to a realignment of the highway. In 2003, blue cohosh was recorded at 20 locations in 4 general areas.

Rosy Sedge (*Carex rosea*)

Rosy sedge is listed as S3 (ACCDC 2003). It is not rare nationally, and NBDNRE (2002a) has listed the species as "Secure". This species was recorded at four locations (Figures 5.5.1-A, 5.5.1-B, and 5.5.1-C Appendix D, and Figure 5.5.6), all within the Project footprint.

Heartleaf Twayblade (*Listera cordata*)

Heartleaf twayblade is listed by the ACCDC (2003) as borderline S3S4. It is not rare nationally, and NBDNRE (2002a) has listed the species as "Secure". Heartleaf twayblade typically grows in the shade on moist banks and in coniferous swamps and bogs, particularly cedar swamps and bogs. This species was recorded at two locations, one inside (Figure 5.5.1-D, Appendix D, and Figure 5.5.10) and one outside the Project footprint (Figure 5.5.1-C, Appendix D).

Fen Grass-of-Parnassus (*Parnassia glauca*)

Fen grass-of-Parnassus is uncommon to rare in New Brunswick, typically found on calcareous rocky shores and in marly bogs (Hinds 2000). It is not rare nationally, and NBDNRE (2002a) has listed the species as "Secure". ACCDC (2003) lists this species as S3. Fen grass-of-Parnassus was found at one location, near *Valeriana uliginosa* on the Big Presque Isle Stream, approximately 90 m downstream of the westbound lane centreline (Figure 5.5.1-C, Appendix D).

Black-seed Plantain (*Plantago rugelii*)

The provincial population status of black-seed plantain (*Plantago rugelii*) has recently (2002) been changed from a ranking of S1 to S3 by ACCDC (2003), and is considered "Secure" by the province (NBDNRE 2002a). This species is native to North America but is believed to have been introduced to New Brunswick. It is easily overlooked because of its superficial resemblance to the common plantain (*P. major*), a common introduced Eurasian species. It is likely for this reason that the population status of black-seed plantain has been changed to S3 and it is now considered secure by the province.

This species was recorded at two locations within the Project footprint (Figure 5.5.1-A, Appendix D), as well as at several others outside the Project footprint, usually along woods roads and trails. One recorded location was on a woods road intersection near the westbound lane centreline, where four specimens were identified among a large population of the common plantain. The second location was identical habitat where a woods road crosses Graham Brook, downstream of the Project footprint. The



species was noted on other woods roads in the area located outside of the Project footprint as well as on an exposed gravel bar on the River de Chute just downstream of the Project footprint.

Hidden-scaled Sedge (*Carex cryptolepis*)

Hidden-scaled sedge is listed by the ACCDC (2003) uncommon (S3). NBDNRE (2002a) has listed the species as "Secure". This species is typically found in sandy or mucky shores, ditches, swales and occasionally in bogs (Hinds 2000). ACER (2003) reported hidden-scaled sedge at Wetland 11 (Figure 5.5.1-B, Appendix D), outside the Project footprint.

Lesser Tussock Sedge (*Carex diandra*)

Lesser tussock sedge is listed by the ACCDC (2003) as uncommon (S3). NBDNRE (2002a) has listed the species as "Secure". Lesser tussock sedge is a species with a very broad distribution and in North America occurs from Alaska to Newfoundland and south to California and New Jersey. In the Maritimes, lesser tussock sedge occurs in the northern mainland and on Cape Breton Island in Nova Scotian bogs, cat-tails swales and marshes, where it is said to be common and locally abundant (Roland 1998). In New Brunswick, it is recorded from scattered sites along the north and east coast and parts of Carleton, Victoria and Restigouche Counties. Lesser tussock sedge is typically found in bog or fen lowlands (Hinds 2000). ACER (2003) reported lesser tussock sedge at Wetland 11 (Figure 5.5.1-B, Appendix D), outside the Project footprint.

5.5.4.3.4 COSEWIC Species

In November 2003, subsequent to the field surveys conducted for the Project, butternut (*Juglans cinerea*) was designated endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2003). Although butternut is considered by COSEWIC to be widespread in southern Ontario, Quebec and New Brunswick, this species has been designated endangered because of a projected decline due to butternut canker (COSEWIC 2003). Butternut canker has been detected in all three provinces and high rates of infection and mortality, observed in Ontario, are predicted for Quebec and New Brunswick populations (COSEWIC 2003).

Butternut is listed by Hinds as "common and native in the Saint John River Valley and Upper Southwest Miramichi River valley" (Hinds 2000). Hinds (2000) indicates the species occurs throughout the above-named valleys, as well as within valleys of several of the major tributary rivers of the lower Saint John River. NBDNR (unpublished) suggests that, relative to overall abundance of other tree species in the province, butternut might be better classed as uncommon, although it is locally abundant on some floodplain sites.



Butternut occurrence is not currently tracked or inventoried by the NB Department of Natural Resources. A conservative estimate indicates a population of between 7,000 and 17,000 mature trees (NBDNR unpublished). The minimum estimate is probably close to true abundance at known sites. However, because sites known constitute an unknown subset of the true total number of sites of occurrence in NB, this minimum abundance estimate is conservative.

Hinds (2000) indicates that butternut occurs or occurred in at least an additional seven sites unfamiliar to NBDNR staff: six within the Kennebecasis and Canaan River drainages (tributary to the lower Saint John River) and a single site in eastern NB. Butternut occurs in three ecoregions within New Brunswick: Eastern Lowlands (Southwest Miramichi River), Valley Lowlands (upper Saint John River), and Grand Lake (lower Saint John River).

Within the Valley Lowlands Ecoregion, the majority of butternut occurrences fall within the Meductic Ecodistrict. This ecodistrict includes much of the upper Saint John River valley (above head-of-tide). The floodplain area of the Saint John River was very narrow within this ecodistrict: most of this area has been lost to hydroelectric development.

Butternut is found on many of the narrow floodplains of tributary streams and on the remaining floodplain of the Saint John River within the Meductic Ecodistrict, but does not form pure stands as in the Aukpaque Ecodistrict. However, in the Meductic Ecodistrict butternut is not largely limited to floodplain soils. Much of the Meductic Ecodistrict is underlain by rich calcareous soils, resulting in butternut being scattered throughout upland hardwood forests.

During the field surveys, no precise data on location and abundance was collected for butternut. In general butternut was found in areas with calcareous soils and was almost always present in rich sites with rare species such as Goldie's fern and plantain-leaved sedge. Butternut was also not infrequently seen along old field edges, and in clear cuts as young trees or semi-suckered growth. In localized rich sites it was considered among the canopy dominants, as a lesser dominant. Three rich hardwood stands (located south of Beaconsfield Road, north of Demerchant Brook and north of Bryson Brook) contained butternut as a dominant canopy species. These three stands are described in more detail in Section 5.5.4.4.2. Butternut was also noted at 11 additional sites within the Assessment Area, including WC4 (Beaconsfield Road), WC7 (Plant Brook), Brown Brook, McMullin Brook, south of Dean Road, in a regenerating clearcut (Figure 5.5.5), south of River de Chute (Figure 5.5.6), north of Guisguilt Brook (Figure 5.5.7), south of Stairs Road (Figure 5.5.8) north of AHF 30A (Figure 5.5.1-C, Appendix D), and north of Palmer Road (Figure 5.5.1-D, Appendix D).

Butternut was encountered during the field surveys frequently enough to not have been considered exceptional. In the site descriptions of rare plant sites, it was included if it was a dominant species,



though it was present at many such rich upland or alluvial sites. In many cases, butternut was noted from areas outside the Project footprint, including along the existing TCH.

5.5.4.4 Appalachian Hardwood Forest (AHF)

5.5.4.4.1 Mature Appalachian Hardwood Forest (AHF) identified by the Nature Trust of New Brunswick

Appalachian Hardwood Forest (AHF), also known as St. John River Valley Hardwood Forest, is defined as a distinct assemblage of tree, understory vascular plant, and bryophyte species found in the central St. John River valley and connecting tributary valleys of western New Brunswick and eastern Aroostook County, Maine. This assemblage type is associated with the moderate climate and well-drained calcareous upland and alluvial bottomland soils of this region (MacDougall and Loo 1998). AHF is a transition forest between southern hardwood forests of central Appalachia and northern hardwood forests of northern New England, the Maritimes, and Quebec.

A very diverse flora that includes 71 vascular plant species (Table 5.5.3) and 116 moss and liverwort species characterizes the AHF. Many of these plant species are rare or uncommon in New Brunswick and are considered to be strongly associated with AHF stands (MacDougall and Loo 1998).

Table 5.5.3 Vascular Plant Taxa Characteristic of Appalachian Hardwood Forest (after MacDougall and Loo 1998)

Scientific Name	Common Name	Scientific Name	Common Name
<i>Acer saccharum</i>	sugar maple	<i>Erythronium americanum</i>	trout lily
<i>Actaea pachypoda</i>	white baneberry	<i>Eupatorium rugosum</i>	white snakeroot
<i>Adiantum pedatum</i>	maidenhair-fern	<i>Fagus grandifolia</i>	beech
<i>Agrimonia gryposepala</i>	agrimony	<i>Festuca subverticillata</i>	nodding fescue
<i>Allium tricoccum</i>	wild leek	<i>Fraxinus americana</i>	white ash
<i>Anemone quinquefolia</i>	wood anemone	<i>Fraxinus nigra</i>	black ash
<i>Aralia racemosa</i>	spikenard	<i>Galearis spectabilis</i>	showy orchis
<i>Arisaema triphyllum</i>	jack-in-the-pulpit	<i>Hepatica nobilis</i>	round-leaved hepatica
<i>Asarum canadense</i>	wild ginger	<i>Impatiens pallida</i>	pale touch-me-not
<i>Betula alleghaniensis</i>	yellow birch	<i>Juglans cinerea</i>	butternut
<i>Botrychium dissectum</i>	dissected grape fern	<i>Ostrya virginiana</i>	ironwood
<i>Botrychium lanceolatum</i>	lance-leaved grape fern	<i>Osmorhiza claytonii</i>	sweet Cicely
<i>Botrychium matricariifolium</i>	daisyleaf grape fern	<i>Phryma leptostachya</i>	lopseed
<i>Botrychium virginianum</i>	rattlesnake fern	<i>Poa alsodes</i>	grove meadow-grass
<i>Cardamine concatenata</i>	cut-leaved toothwort	<i>Polygala senega</i>	seneca-snakeroot
<i>Cardamine diphylla</i>	toothwort	<i>Polygonatum pubescens</i>	Solomon's-seal
<i>Cardamine X maxima</i>	large toothwort	<i>Polystichum acrostichoides</i>	Christmas fern
<i>Carex cephaloidea</i>	thin-leaved sedge	<i>Polystichum braunii</i>	Braun's holly-fern
<i>Carex hirtifolia</i>	pubescent sedge	<i>Ranunculus abortivus</i>	kidney-leaved buttercup
<i>Carex plantaginea</i>	plantain-leaved sedge	<i>Ranunculus recurvatus</i>	hooked buttercup
<i>Carex sprengelii</i>	Sprengel's sedge	<i>Rubus occidentalis</i>	black raspberry
<i>Caulophyllum thalictroides</i>	blue cohosh	<i>Sanguinaria canadensis</i>	bloodroot
<i>Circaea lutetiana</i>	enchanter's nightshade	<i>Sanicula odorata</i>	fragrant snakeroot
<i>Claytonia caroliniana</i>	spring beauty	<i>Sanicula trifoliata</i>	large-fruited snakeroot

Table 5.5.3 Vascular Plant Taxa Characteristic of Appalachian Hardwood Forest (after MacDougall and Loo 1998)

Scientific Name	Common Name	Scientific Name	Common Name
<i>Cryptotaenia canadensis</i>	honewort	<i>Smilacina racemosa</i>	false Solomon's-seal
<i>Cynoglossum boreale</i>	northern wild comfrey	<i>Solidago flexicaulis</i>	zig-zag goldenrod
<i>Cypripedium oarviflorum</i> var. <i>pubescens</i>	yellow lady's-slipper	<i>Taxus canadensis</i>	Canada yew
<i>Deparia acrosticoides</i>	silvery gladefern	<i>Tilia americana</i>	basswood
<i>Desmodium glutinosum</i>	pointed-leaved tick-trefoil	<i>Trillium erectum</i>	red trillium
<i>Dicentra cucullaria</i>	dutchman's-breeches	<i>Triosteum aurantiacum</i>	wild coffee
<i>Dirca palustris</i>	leatherwood	<i>Ulmus americana</i>	American elm
<i>Dryopteris clintoniana</i>	Clinton's shield-fern	<i>Uvularia sessilifolia</i>	sessile-leaved bellwort
<i>Dryopteris clintoniana</i> X <i>goldiana</i>	simulated log fern	<i>Viola canadensis</i>	Canada violet
<i>Dryopteris goldiana</i>	Goldie's fern	<i>Viola pubescens</i>	yellow violet
<i>Dryopteris</i> X <i>dowellii</i>	Dowell's wood fern	<i>Viola selkirkii</i>	great-spurred violet
<i>Elymus hystrix</i>	bottle-brush grass		

AHF is typically a mature tolerant hardwood forest growing on rich, well-drained soils and is rarely found in younger forested areas subjected to previous agricultural or forestry activities. Sugar maple, beech, white ash, yellow birch and ironwood typically dominate the canopy species of AHF. The presence of basswood and butternut in these stands often indicate a species-rich understory. The understory vascular plant assemblages of AHF are typically associated with moist, seepy areas (MacDougall and Loo 1998).

The St. John River valley, from Meductic to Beechwood, contains the most species-rich assemblages of AHF and typical species assemblages are most concentrated within the Meduxnekeag River watershed (MacDougall and Loo 1998).

The NTNB initiated a Conservation Stewardship Program to inventory the size, abundance and distribution of AHF fragments in the central St. John River Valley, with the intent to conserve significant AHF fragments identified in the program (MacDougall 1997). AHF fragments were given conservation priority rankings of "very high", "high", "moderate" or "low".

Very high priority sites (MacDougall 1997) were defined as those that:

- contained one or more provincially or nationally "very rare" plant species;
- contained a few or many uncommon or rare AHF plant species;
- contained a rich assemblage of common AHF plant species;
- had limited recent disturbance; and/or
- had largely undisturbed mature tolerant hardwood canopy.

High priority sites (MacDougall 1997) were defined as those that:

- contained a few or many rare AHF plant species;
- contained a rich assemblage of common AHF plant species;
- had limited recent disturbance; and/or
- had a largely undisturbed mature tolerant hardwood canopy.

Moderate priority sites (MacDougall 1997) were defined as those that:

- contained one or a few rare AHF plant species;
- contained a moderate assemblage of common AHF plant species;
- were recently partially clear-cut or selectively cut;
- had largely undisturbed mature tolerant hardwood forest canopy, but limited understory diversity; and/or
- were located near a high or very high priority site.

Low priority sites (MacDougall 1997) were defined as those that:

- displayed an absence of rare AHF plant species;
- contained few or no common AHF plant species;
- were completely or partially clear-cut;
- were heavily select cut with no evidence of mature trees; and/or
- were incorrectly identified as mature tolerant hardwood.

Locations of AHF identified in the program were provided by the NTNB (Betts 1999). A total of 21 AHFs totaling approximately 404 ha were identified within the Assessment Area (*i.e.* 22 map tiles; see Section 5.5.2.2). Six AHF stands are shown in Figure 5.5.1 A-D (Appendix D), between the Project limits; two additional stands occur just outside the limits of the Project in the Perth-Andover and Woodstock areas. Of the stands located in the area, the Project footprint will bisect two of the stands (Hunters Brook AHF and Big Presque Isle Stream AHF) and will just avoid a third stand (Reid Lake AHF). Information collected on the AHF stands in 1997 in the Assessment Area was provided by NTNB (J. Simpson, pers. comm. 2003).

The Hunters Brook AHF (AHF-30a, Figure 5.5.1-C, Appendix D) is bisected by a power line RoW from north to south. The western side of this AHF was relatively undisturbed and described as mature tolerant hardwood with many large sugar maple and American ash. The western side of the Hunters Brook AHF is considered a moderate priority site. Yellow lady's-slipper and northern maidenhair-fern have been recorded in the western side of this AHF. The eastern side of the Hunters Brook AHF was described as young, even-aged tolerant hardwood that is species poor, however, leatherwood has been



recorded in the eastern side. The powerline RoW currently bisects the Hunters Brook AHF in the same area as the proposed TCH route. At the time of the vegetation surveys in 2002 and 2003, the southern half of the site and east of the powerline had been clear-cut. Following a search of the AHF site, concentrating within the footprint, one uncommon species associated with AHF, yellow lady's-slipper, was found in this area, west of the Project footprint. The eastern and southern portion of the Hunters Brook AHF site that will be crossed by the Project footprint would be considered a "low priority" site according to MacDougall's (1997) conservation priority ranking.

The Big Presque Isle Stream AHF (AHF-28, Figure 5.5.1-C, Appendix D) was described by NTNB as a large mature hardwood forest with spring ephemeral species. Although the stand is considered to be "moderate priority" due to its large size and the presence of rare moss species, much of the stand is heavily disturbed and continues to be harvested. A high-tension powerline RoW bisects the stand. The forest stands along the proposed TCH route in the vicinity of Big Presque Isle Stream are described as mature hemlock, white pine, balsam fir and sugar maple stands (Dillon 2003). No rare or uncommon species associated with AHF were found within the original Project footprint by Dillon (2003) in this area, nor in the realigned Project footprint by JWEL in 2003.

At the Big Presque Isle AHF site (#28) along the east and west sides of the transmission line (located west of the Project RoW) within 1 km of the stream, two uncommon to rare mosses (unranked by the ACCDC) *Anomodon rugelii* and *Raiiella scita* were recorded. These same uncommon mosses were discovered at a number of other AHF sites, including Site #17 (Figure 5.5.1-C), located approximately 1 km southwest of Flanagan Hill, 3.5 km southeast of Connell, well outside of the Project RoW. The rare moss *Ditrichum pallidum* (S1) was also found at Site #17. Also of note, a small calcareous fen approximately 1.7 km north of Big Presque Isle Stream and west of the Project RoW contains the rare mosses *Hypnum pratense* (S1S2) and *Helodium blandowii* (S2) and other uncommon bryophytes of fen habitat, including the uncommon mosses *Tomenthypnum nitens*, and *Drepanocladus aduncus*, and the uncommon liverwort *Cololejeunea biddlecomiae*, all currently unranked by the ACCDC. This fen will not be affected by the Project.

The ACCDC rankings and records of mosses are available for the rarest of mosses (S1, S1S2 and S2), however there are no rankings for the other species mentioned above. The two rare (S1 and S1S2) species above were included in the data provided by the ACCDC, however the records are not within the RoW. A status ranking for nonvascular plants by the Province (NBDNR), is not available (Maureen Toner, pers. comm.).

The Reid Lake AHF (AHF-43, Figure 5.5.1-B, Appendix D) was identified by the NTNB as one of the highest priority AHF sites in the Assessment Area. This site is described as a combination of wet seep, dry mature tolerant hardwood and alluvial shoreline with sugar maple, American ash, yellow birch and American elm. The Reid Lake AHF is considered a very high priority site with high species diversity

and rare and very rare plants. Rare vascular plants recorded at the site include Goldie's fern, Braun's holly fern, plantain-leaved sedge, bottle-brush grass, nodding fescue, yellow lady's-slipper, showy orchis (*Galearis spectabilis*) and lopseed. Of the many rich areas within the site, only one seepy site appears to be close to (but still outside) the Project footprint, and it is considered the least rich of the rich areas, with Goldie's fern the only rarity recorded.

Two AHF stands within or near the Assessment Area are also considered to be ESAs. The Moody (Iron Ore) Deciduous Stand is located west of Jacksonville, between Routes 550 and 560, approximately 1.2 km from the Project footprint. This deciduous forest community has a history of variable disturbance, resulting in densely forested lower slopes and open upper slopes. Butternut and several rare plant species are found at this site, including as Goldie's fern, showy orchis and maidenhair fern. The Woodstock-Meduxnekeag Bridge is located on the banks of the Meduxnekeag River west of Woodstock, west of the bridge on the existing TCH, approximately 0.5 km from the Project footprint. This site is a calcareous woods and river edge with interesting floral assemblage including rare and uncommon species such as Goldie's fern, showy orchis, yellow lady's-slipper and maidenhair fern. There will be no interaction between the Project and these two AHF stands.

5.5.4.4.2 Potential Appalachian Hardwood Forest

Although the information collected from the NTNB indicates that there are 404 ha of AHF in the Assessment Area, the digital forest cover data used by the NTNB is from 1981 which precedes current hardwood classification methods updated in 1995. Based on the NTNB query methodology (MacDougall 1997) using 1996 and 2000 forest data including areas with suitable tree canopy (*i.e.*, immature old to mature tolerant hardwood species) and soil type, there are 3,855 ha of "potential AHF" in the Assessment Area. However, these areas of "potential AHF" have not been confirmed by ground-truthing. In New Brunswick's provincial land classification AHF corresponds with Ecosites 7L, 7C, and 8C within the St. John River Valley Ecodistrict (MacDougall 1997).

Five "potential AHF" stands were identified, however, during the vegetation surveys. ACER (2003) reported one area that contained rare and uncommon species associated with AHF (Figure 5.5.8). This area is located south of Stairs Road, in forest Ecosite 7L, identified as mixedwood highly calcareous upper slope, and characteristic of AHF. This site is described as a hardwood ravine and contains plant assemblages characteristic of AHF, including lopseed, plantain-leaved sedge and maidenhair-fern. Goldie's fern was also found in the area by JWEL in 2003. These plants persist, though the area was clear-cut both recently and in the past.

During rare plant surveys in 2003, JWEL reported another area that contained rare and uncommon species associated with AHF. This area is located south of Route 560, in forest Ecosites 7L and 8L, identified respectively as mixedwood highly calcareous upper slope and hardwood highly calcareous



ridge (Figure 5.5.6). Plant assemblages characteristic of AHF included bottle-brush grass, Goldie's fern, leatherwood and maidenhair-fern. This site has undergone significant forest harvesting over the years, but rare species assemblages have been able to persist.

During the vegetation survey carried out by JWEL (2003a) in 2002, three rich hardwood stands (Figure 5.5.1-A, Appendix D) were identified in the Assessment Area. These three stands displayed previously unknown plant assemblages characteristic of AHF and are described below. A shift in the proposed TCH route has resulted in avoidance of these rich hardwood sites; all three are located outside the Project footprint.

Rich Hardwood Stand South of Beaconsfield Road

The rich hardwood stand (Figure 5.5.1-A, Appendix D) is situated in the flood plain of an intermittent stream that flows through a partially harvested rich sugar maple, ash and butternut dominated forest stand. This partially-cut tolerant hardwood site is surrounded on three sides by cleared land, with agricultural land immediately to the north and south, and a recent clear-cut to the east. Rare or uncommon vascular plant species were recorded within approximately 50 m of the drainage channel. A downstream portion of the intervale habitat has been clear-cut to the edge of the channel, yet still contained rare species. This site is located within Ecosites 5 and 8, not consistent with the three ecosites normally associated with AHF.

A total of six rare or uncommon vascular plant species were recorded within the intervale habitat (Figure 5.5.2). Goldie's fern is distributed along the intervale in two large patches separated by a logging road. Canada clearweed is found on the downslope side of the logging road. A second larger population of Canada clearweed is found on a second logging road. A patch of yellow lady's-slipper and a single grouping of 22 plantain-leaved sedge rosettes are located just upslope of the intervale. The remaining rare vascular plants in this intervale include a large patch of northern maidenhair-fern among the Goldie's fern, a single fragrant black snake-root near the Goldie's fern, and various clumps of northern maidenhair-fern and plantain-leaved sedge further downstream. Much of the large patch of Goldie's fern and northern maidenhair-fern, as well as a good portion of the northern maidenhair-fern and plantain-leaved sedge clumps are within a recent clear-cut.

Additional rare species were recorded in 2003 in a nearby intervale habitat 100 m south of this site, however had recently endured even more disturbance from harvesting. These species included pale touch-me-not, nodding fescue, and Braun's holly fern.



Rich Hardwood Stand North of Demerchant Brook

This rich hardwood stand (Figure 5.5.1-A, Appendix D) is located 1 km to the north of the rich hardwood stand located north of Bryson Brook. Both rich hardwood stands are similar in tree and shrub species composition as well as soil fertility, drainage conditions and topography. The forest inventory description for this stand is identical in all respects to that of the rich hardwood stand north of Bryson Brook (see below). The site actually comprises two distinct seepy areas, separated a distance of 50 m by a drier ridge that did not contain any rarities. Downslope of this stand are mature mixedwood stands dominated by poplar and balsam fir. This site is located within Ecosite 8, which is not consistent with the three ecosites normally associated with AHF.

This rich site contained the highest concentration of rare and uncommon species. The nine species include Canada violet, plantain-leaved sedge, Sprengel's sedge, Goldie's fern, lopseed, Canada clearweed, northern maidenhair-fern, yellow lady's-slipper and blue cohosh (Figure 5.5.3). Other more common species characteristic of AHF were also found at this site including smooth yellow violet, bloodroot, silvery spleenwort, trout lily, Dutchman's-breeches, spring beauty, and wild ginger.

This was the only site where Canada violet was recorded. It was found on the more northern seep, mostly at the upper end of the slope. Plantain-leaved sedge was found scattered in both seepage areas, and in total numbered approximately 1,000 individuals in 36 patches. This represents more than two thirds of the total number of individuals of this species recorded during the survey. Goldie's fern was mostly found in one large patch that spanned the length of the more northern seep, but was absent from the other seep. In contrast, lopseed was only found in the more southern seep at four discrete locations. Canada clearweed was found in two patches, one near each of the seeps. Several northern maidenhair-fern and two patches of yellow lady's-slipper were found at this site, one in each seepage area. Blue cohosh was found scattered near the top of the seepage track near the Canada violet distribution.

Rich Hardwood Stand North of Bryson Brook

The rich hardwood stand north of Bryson Brook (Figure 5.5.1-A, Appendix D) is dominated by sugar maple, American ash, black ash and butternut. Scattered beaked hazelnut and occasional red elderberry and mountain maple were present in the shrub layer. This hardwood slope is characterized by the presence of intermittent surface water drainage courses and subsurface seeps that are not overly moist in late summer. The soils of this site are alluvial in nature and are probably very rich in calcium and other nutrients. This site resembles a rich, moist seepy area within a remnant of AHF as described by MacDougall and Loo (1998). However, this site is located within Ecosite 8, which is not consistent with the three ecosites normally associated with AHF.



This forest stand is classed as an immature-old, tolerant hardwood stand on NBDNR Forest Inventory Mapping (1996 aerial photography). The dominant species are sugar maple (60 percent), beech (20 percent), and yellow birch (10 percent), as well as other mature hardwoods (10 percent). Canopy cover is 70-90 percent, canopy height is 18 m, and merchantable trees in the stand have dbh's (diameter at breast height) ranging from 16 to 24 cm. The tolerant hardwood stand contains older individual trees, however the typical elements of a truly mature forest, such as coarse woody debris, are not present. Downslope of this stand are mature mixedwood stands dominated by poplar and balsam fir. Immediately south of this rich area is a recent clear-cut.

A total of five rare or uncommon species were recorded at this site, including Goldie's fern, plantain-leaved sedge, northern maidenhair-fern, yellow lady's-slipper, and blue cohosh (Figure 5.5.4). Other more common herbaceous species included wild ginger, blood root, silvery spleenwort, and smooth yellow violet. Spring ephemeral species recorded in June 2003 included trout lily, Dutchman's-breeches, and spring beauty. The site contains the largest population of yellow lady's-slipper and northern maidenhair-fern recorded along the highway route. Goldie's fern was concentrated mostly in a large, 0.30 ha patch, as well as scattered clusters of plants, while plantain-leaved sedge was restricted to only 6 discrete patches. Blue cohosh was scattered near the large patch of Goldie's fern, with a total of about 15 plants.

5.5.5 Environmental Effects Analysis

5.5.5.1 Project-VEC Interactions

Table 5.5.4 provides a summary of the potential environmental effects resulting from the Project-VEC interactions, including those of past, present and likely future projects. The table is divided according to each of the Project phases assessed (construction, operation and maintenance), as well as malfunctions, accidents and unplanned events. The discussion following the table provides an analysis of key Project-VEC interactions, by Project phase.

Table 5.5.4 Project Activity - Environmental Effects Interaction Matrix for Vegetation

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>VEGETATION</u>			
Project Activities and Physical Works	Change in Habitat Quantity	Change in Habitat Quality	Loss of Species of Special Conservation Concern
Construction			
Site Preparation	✓	✓	✓
Roadbed Preparation			
Surfacing and Finishing			
Watercourse Crossing Structures	✓	✓	✓
Ancillary Structures and Facilities Construction	✓	✓	✓



Table 5.5.4 Project Activity - Environmental Effects Interaction Matrix for Vegetation

Potential Interactions Between Project Activities and Environmental Effects			
Valued Environmental Component: <u>VEGETATION</u>			
Project Activities and Physical Works	Change in Habitat Quantity	Change in Habitat Quality	Loss of Species of Special Conservation Concern
Operation			
Winter Safety		✓	✓
Proposed TCH Presence		✓	
Maintenance			
Highway Maintenance			
Vegetation and Wildlife Management			
Accidents, Malfunctions and Unplanned Events			
Hazardous Materials Spills		✓	✓
Erosion and Sediment Control Failure		✓	✓
Bridge or Culvert Washout			
Fires		✓	✓

5.5.5.1.1 Construction

There are several construction activities related to the Project that could affect the Vegetation VEC. The most substantive and likely interactions are a change in habitat quantity or quality (including AHF) and the possible loss of species of special conservation concern if they are present, as a result of the site preparation activities, as well as ancillary structures and facilities. Construction of selected watercourse crossings also have the potential to affect rare vascular plants.

Site Preparation

Clearing and grubbing for site preparation will remove vegetation and, particularly in forested areas, will change the quality of the habitat along the edge of the Project footprint. Vegetation and habitat within the Project footprint will be permanently displaced. Forest clearing will alter the habitat bounding the Project footprint, allowing for more sun-tolerant species to establish and reducing habitat for shade-dependent species.

Rare ("May Be At Risk" or "Sensitive") species that are potentially directly affected by site preparation activities within the Project footprint or at access roads include calypso, hooked agrimony, plantain-leaved sedge, showy lady's-slipper, Goldie's fern, lopseed, Canada clearweed, lesser bladderwort, northern maidenhair-fern, yellow lady's-slipper, and Braun's holly fern.

A single calypso (S2, "May Be At Risk") specimen is located inside the Project footprint. The four specimens found outside the footprint are approximately 50 m outside the Project footprint. As long as the habitat is protected during construction, and design of the highway at this location considers maintenance of hydrology at the site, then the potential for adverse environmental effects on the population of calypso in the area is low.



Hooked agrimony (S2, "Sensitive") was identified at two locations, both on the westbound lane centreline. Nonetheless, it is the opinion of the surveyors that a viable population of hooked agrimony is located outside the Project footprint. Its precise status is somewhat unclear due to its close similarity to the much more common roadside agrimony (*Agrimonia striata*), and it likely belongs in the S3 category (S. Blaney, pers. comm. 2002).

Plantain-leaved sedge (S2, "Sensitive") was recorded at eight sites in the Assessment Area. At two of these sites, a portion of the population of this species is located within the Project footprint. Five of the plantain-leaved sedge sites will not be directly affected by the highway.

Of the showy lady's-slipper (S2, "Sensitive") recorded in the Assessment Area, only the 20 plants noted in 2002 are within the Project footprint. The remaining 37 plants are 20 to 75 m outside the footprint. Efforts will be made during the design and construction of the TCH at this location to maintain the hydrology of the site.

Goldie's fern (S2, "Sensitive") was one of the most abundant of the rare plant at the three rich areas identified by JWEL in 2002, occupying large areas that are avoided due to re-routing of the proposed TCH route. The largest population was recorded 75 m from the footprint at Brown's Brook. This species was recorded in 11 areas with seven of these outside the Project footprint.

At the lopseed (S2, "Sensitive") site south of Stairs Road (Dillon 2003), most of the plants are within the proposed Project footprint. Lopseed has been recorded in 2002 at one other site, and previously at four additional sites, all of which are avoided by the Project footprint.

Canada clearweed (S2, "Sensitive") was recorded at 19 locations between Perth-Andover and Big Presque Isle Stream. An estimated 15 % of the plants are located within the proposed Project footprint, and 14 sites will be avoided. A portion of the plants recorded at Wetland 8 will be lost.

Lesser bladderwort (S2, "Sensitive") was recorded at two locations in the surveyed area. At one site (Wetland 3), the area where this species was recorded is within the Project footprint, however it is likely that this species is located elsewhere in this wetland.

Northern maidenhair-fern (S3, "Sensitive") was one of the more widely distributed of the "Sensitive" class plants and yet was generally patchy in distribution and always associated with richer sites and microhabitats. In total, this species was noted in 11 general areas in the area surveyed (ten north of Dryer Road), of which a viable population will remain in eight of these.

Yellow lady's-slipper (S3, "Sensitive") was recorded at 66 locations in 16 general areas, with 11 areas containing plants outside the Project footprint. In general, as appears to be the case for northern



maidenhair-fern, it was one of the more widely distributed of the "Sensitive" class plants and yet was patchy in distribution and always associated with richer sites and microhabitats.

Braun's holly fern (S3, "Sensitive") was found at two locations in the Assessment Area. One site was located just south of the rich hardwood stand south of Beaconsfield Road (Figure 5.5.2) and the second was found south of Backland Road. Both records consisted of single plants growing on the fertile banks of intermittent streams. At the second site south of Backland Road the specimen was found within the Project footprint. Braun's holly fern has been recorded at least 33 locations in New Brunswick, and at least five sites are located within the Assessment Area (Hinds 2000). These five recorded Braun's holly fern sites are located outside the footprint of the Project.

Butternut (endangered) was found frequently in the Assessment Area, mainly associated with rich upland and alluvial sites. This species was not flagged as a species of special conservation concern during the field surveys and details on locations and abundance were not recorded. However, it is not likely that some of the butternut encountered is located within the Project footprint.

Two stands of AHF, Hunters Brook AHF (AHF-30a, Figure 5.5.1-C, Appendix D) and the Big Presque Isle Stream AHF (AHF-28, Figure 5.5.1-C, Appendix D), will be bisected by the Project footprint. Both stands were recently clear-cut within the Project footprint. Although the clearing of the Hunter's Brook AHF was not likely associated with the Project, cutting within the Big Presque Isle Stream AHF was likely accelerated because of the Project. Only one uncommon species associated with AHF, yellow lady's-slipper, was found in the Hunters Brook AHF, located west of the Project footprint (AHF-30a, Figure 5.5.1-C, Appendix D). No rare or uncommon vascular plant species associated with AHF were found within the Project footprint in the Big Presque Isle Stream AHF (AHF-28, Figure 5.5.1-C, Appendix D).

Of the 404 ha of AHF known to occur in the Assessment Area, approximately 6.8 ha (1.7 percent) will be cleared during construction of the Project. During the plant surveys carried out by Dillon (2003) and JWEL (2003a) in 2002, and by JWEL in 2003, five sites along the proposed and alternative alignments were identified that display characteristics of AHF. Rare vascular plants in four of these sites will be avoided by the current alignment. Although the information collected from the NTNB indicates that there are 404 ha of AHF in the Assessment Area, the digital forest cover data used by the NTNB is from 1981 which precedes current hardwood classification methods updated in 1995. Based on the NTNB query methodology (MacDougall 1997) using 1996 forest data but including the immature tolerant hardwood forest type, there are 3,855 ha of additional "potential AHF" in the Assessment Area that may have been investigated by the NTNB. However, these areas of "potential AHF" have not been ground truthed.



Watercourse Crossing Structures

The proposed TCH will require the installation of culverts and bridges. Improper installation of watercourse crossings can alter aquatic or wetland habitat on which some plant species are dependent. Improperly installed crossings can result in flooding or extensive erosion.

The Big Presque Isle Stream bridge crossing has the potential to interact with mountain valerian (S2, "May Be At Risk"). Due to the size of Big Presque Isle Stream a freespan structure will be installed. Four small patches of mountain valerian are located approximately 80 m east of the westbound centreline of the highway. Potential interactions will depend on the final design of the bridge structure, however, this species is not expected to be affected.

Patches of rare and uncommon vascular plant species that are not directly affected by watercourse crossing structures may be indirectly affected by changes in hydrology. There is some potential for alteration of the hydrology of the area as a result of Project activities (e.g., ponding if culverts are placed too high, or drainage if they are placed too low). Thus, the final design must ensure the hydrology of each area is maintained.

Eight watercourse crossings have the potential to indirectly affect rare or uncommon vascular plants located upstream or downstream of the crossing due to changes in local hydrology. Refer to Figure 3.2 A to D (Appendix C) for locations of the following watercourses. WC5 (tributary to Saint John River) is located upstream of a rich area where nodding fescue, pale touch-me-not, plantain-leaved sedge, Goldie's fern and Braun's holly fern are found. WC6 (tributary to Saint John River) is located upstream of a yellow lady's-slipper site. WC11 (tributary to Brown Brook) is located upstream of a Goldie's fern site. WC12 and WC13 (tributaries to Brown Brook) are both located upstream of areas containing Goldie's fern and northern maidenhair fern. WC16 (Graham Brook) is located upstream of a site containing black-seed plantain. WC20 (Upper Guisguait Brook) is located downstream of an area containing northern maidenhair fern and plantain-leaved sedge. WC22 (tributary to Lower Guisguait Brook) is located downstream of an area containing lesser bladderwort, hidden-scaled sedge and lesser tussock sedge.

At WC22, lesser bladderwort (S2, "Sensitive") occurred within a beaver pond, upstream of the Project footprint. Although the lesser bladderwort is located upstream of the proposed Project footprint, changes in wetland hydrology due to the likely removal of the beaver dam may affect the abundance and distribution of lesser bladderwort at this site. Hinds (2000) describes lesser bladderwort habitat as "...shallow pools and boggy meadows". Some habitat that can maintain a viable population of lesser bladderwort may remain upstream of the Project footprint after construction.



Ancillary Structures and Facilities

Construction of temporary ancillary structures and facilities, such as access roads, borrow areas and disposal sites, has the potential to have interactions with vegetation similar to those of site preparation activities, though on a smaller scale.

Access Road "F" has the potential to interact with a patch of yellow lady's-slipper (Figure 5.5.1-A, Appendix D). Yellow lady's-slipper was recorded at 66 locations in 16 general areas. As discussed previously, this species was one of the more widely distributed of the "Sensitive" class plants, and therefore a viable population will remain following construction.

Access Road "J" will cut through the western edge of the Big Presque Isle Stream AHF (Figure 5.5.1-C, Appendix D). No rare or uncommon species associated with AHF were found within the Project footprint in the Big Presque Isle Stream AHF.

5.5.5.1.2 Operation

Winter Safety

During winter, salt is used by NBDOT on road surfaces to aid in melting snow, and to provide clear road conditions. Road salt can enter into the environment (surface water, groundwater and soil) through storage and application of these salts. The highest concentrations are usually associated with winter and spring thaws. Environment Canada (2001c) cites numerous studies attributing vegetation damage and changes in plant community composition to road salt application. Potential effects of aerial dispersion of salt and/or elevated salt content in soils include: reduced flowering and fruiting; leaf, shoot and root damage; reduced growth; and reduced seedling establishment. Environment Canada (2001c) indicates that vegetation damage from aerial dispersion can occur up to 200 m from salt-treated multi-lane highways and 35 m from salt-treated two-lane highways. Blomqvist (2001) found that, while salt spray deposition can occur several hundred metres from a treated highway, over 90 % of the spray is deposited within 40 m of the highway.

Twenty-four of the rare and uncommon vascular plant species recorded in the Assessment Area are located within approximately 200 m of the highway. The vast majority of these plants will have a forested buffer between the plant location and the highway, therefore salt spray will likely be intercepted prior to reaching these rare plants. "May Be At Risk" or "Sensitive" vascular plant species that may have a greater potential to receive salt spray deposition include bottle-brush grass, calypso, mountain valerian, plantain-leaved sedge, Sprengel's sedge, Goldie's fern, northern maidenhair-fern, lance-leaf grapefern, and yellow lady's-slipper.



Bottle-brush grass (S1, "May Be At Risk") was recorded at five locations in one site along the proposed TCH route. The four largest patches of this species should not be affected by winter salting. One patch consisting of one plant may be affected by winter salting.

Overall, most of the plantain-leaved sedge (S2, "Sensitive"), Goldie's fern (S2, "Sensitive"), northern maidenhair-fern (S3, "Sensitive") and yellow lady's-slipper (S3, "Sensitive") sites will not be directly affected by winter salting. Clammy-hedge-hyssop (S2S3, secure) is an annual species, and would not be directly affected during salt application or during snowmelt.

Mountain valerian (S2, "May Be At Risk"), nodding fescue (S1, "May Be At Risk"), pale touch-me-not (S1, "May Be At Risk"), Calypso (S2, "May Be At Risk"), lesser bladderwort (S2, "Sensitive"), and Braun's holly fern (S3, "Sensitive") could be affected by winter salting should salt application result in contamination of the habitat. Sprengel's sedge (S2, "Sensitive") and lance-leaf grapefern (S3, "Sensitive") were each recorded at only one location within 40 m of the Project footprint, with one or very few individuals, which may not represent viable populations.

Three stands of AHF may be affected by road salt application. These include the Hunters Brook AHF and Big Presque Isle Stream AHF, which will be bisected by the Project footprint, as well as the Reid Lake AHF, which is adjacent to the Project footprint.

Proposed TCH Presence

During the Project-related activities associated with proposed TCH presence, there is a potential for a change in water quantity, and therefore vegetation habitat quality. The contribution to runoff from the proposed TCH will be more episodic, compared to the more gradual release of water from forested/vegetated areas, however, the potential for a substantive change in the quantity of surface water due to the highway construction is low because the surface area of the highway is relatively small compared to the area of the watersheds upgradient of the crossings of most of the watercourses.

5.5.5.1.3 Maintenance

Clearing along the proposed TCH is part of NBDOT's regular maintenance to maintain sight lines and may involve both manual and mechanized cutting. Vegetation cutting will occur within the footprint of the Project that has been previously disturbed for site preparation and hydroseeded. With the exception of accidents, malfunctions and unplanned events that could occur during maintenance activities, which are discussed in Section 5.5.5.1.4, maintenance activities have little or no potential for interaction with Vegetation.



5.5.5.1.4 Accidents, Malfunctions and Unplanned Events

Accidents, malfunctions and unplanned events that may occur in association with the Project and have and adverse environmental effect on vegetation include:

- hazardous material spills;
- erosion and sediment control failure; and
- fire.

Hazardous material spills may damage habitat and/or cause direct mortality of vegetation. Hazardous material spills could be the result of construction activities (e.g., equipment fuelling or faulty vehicle components), operation activities (e.g., hazardous material transport truck accident, or excessive salt application), or maintenance activities (e.g., equipment fuelling).

Erosion and sediment control measures could fail during heavy precipitation events, resulting in erosion of vegetation habitat.

Fire could remove vegetation and alter habitat in the Assessment Area. Also, burned forest land may be converted for agriculture. Fire may also result in the loss of AHF in the Assessment Area. Fire may be caused as a result of construction activities (e.g., hot equipment), operation activities (e.g., discarded cigarettes or hot exhaust systems in contact with roadside vegetation), and maintenance activities (e.g., hot equipment).

5.5.5.2 Environmental Effects Analysis and Mitigation

The discussion following provides an analysis of key project-VEC interactions, by Project phase.

5.5.5.2.1 Construction

The following provides an evaluation of key potential project-VEC interactions for the construction phase of the Project as summarized in the environmental effects assessment matrix (Table 5.5.5). During construction of the proposed TCH and associated roads and structures, several activities could result in a change in vegetation or habitat. These include any activities that involve vegetation clearing, soil disturbance or hydrological modifications (site preparation, road preparation, watercourse crossing, and ancillary structures and facilities construction). The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects.



Table 5.5.5 Environmental Effects Assessment Matrix for Vegetation (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>VEGETATION</u> Phase: <u>Construction</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Site Preparation	- Change in habitat quantity (A) - Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Avoidance by re-routing - Limit area of disturbance - Follow EPP and EFG - Develop and implement site specific EPP measures to protect AHF and rare plant concentrations - Include AHF and rare vascular plants in employee awareness training - Use designated roadways and access; limit off road activity - Erosion control measures - Purchase of high priority AHF stands and proximal rare plant concentrations that have been avoided	2	4	5/6	1 2
Watercourse Crossing Structures	- Change in habitat quantity (A) - Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Planning for watercourse installation using NBDOT and Watercourse Alteration Technical Guidelines - Follow EPP and EFG - Implement site specific EPPs - Limit area of disturbance - Erosion control measures	1	1	1/1	R 2
Ancillary Structures and Facilities Construction	- Change in habitat quantity (A) - Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Limit area of disturbance - Follow EPP and EFG - Use designated roadways and access; limit offroad activity - Erosion control measures	1	1	4/6	R 2

Key:

Magnitude:

- 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation
- 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability
- 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation

Geographic Extent:

- 1 = <1 km²
- 2 = 1-10 km²
- 3 = 11-100 km²
- 4 = 101 - 1,000 km²
- 5 = 1,001 - 10,000 km²
- 6 = >10,000 km²

Duration:

- 1 = <1 month
- 2 = 1 - 12 months
- 3 = 13 - 36 months
- 4 = 37 - 72 months
- 5 = >72 months

Frequency:

- 1 = <11 events/year
- 2 = 11 - 50 events/year
- 3 = 51 - 100 events/year
- 4 = 101 - 200 events/year
- 5 = >200 events/year
- 6 = continuous

Reversibility:

- R = Reversible
- I = Irreversible

Ecological/Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse environmental effects.

N/A = Not Applicable

(A) = adverse

(P) = positive



Site Preparation

As previously indicated in Section 2.2, the route selection process began in 1987. During the route selection process, regulators and stakeholders identified known locations of environmentally sensitive areas for plants and AHF within the proposed route corridors. AHF lands were avoided to the extent possible.

NBDOT commissioned a number of background environmental data surveys in 2002 and additional surveys in 2003 in support of this environmental assessment. A number of realignments were made as a result of the issues identified during these surveys and subsequent consultation with regulatory agencies. The 2003 alignment includes the changes made from Raymond Road to Big Presque Isle Stream and those made to accommodate issues identified during the environmental field studies.

The alignment was shifted to avoid rare vascular plants and AHF habitat characteristics between Hillandale (north of Beaconsfield Road) and south of River de Chute (shift to the west from Hillandale to Plant Brook; shift to the east from Plant Brook to Brown Brook/Scott Road; shift to the east from Scott Road to Graham Brook and River de Chute area) (Figure 2.1 A, Appendix B). The median was reduced to the minimum between Guisguait Brook to B. Smith Road to avoid/minimize encroachment on rare vascular plants (Figure 2.1 B, Appendix B). The alignment was shifted to the east for 1.5 km north of Palmer Road to avoid rare vascular plants (Figure 2.1 D, Appendix B). The Hartland Interchange was shifted to the southeast to avoid rare vascular plants (Figure 2.1 D, Appendix B).

With the exception of a single yellow lady's-slipper at Access Road "F", all access roads avoid rare vascular plants recorded along the alignment. The loss of this single site is not significant.

Although not all of the rare plant habitat and AHF were completely avoided, the 2003 realignment very successfully minimizes disruption to these habitats. In addition, NBDOT has purchased, for conservation purposes, a number of the potential high or very high priority AHF stands and rare plant concentrations that have been avoided. These include:

- the rich hardwood stand north of Demerchant Brook, containing the population of Canada violet;
- the rich hardwood stand north of Bryson Brook;
- the site containing bottle-brush grass, south of River de Chute and Route 560;
- the showy lady's-slipper site at the Hartland Interchange; and
- the Calypso site, between Estey and Palmer roads.

The first three sites being purchased total 72.2 ha of AHF. The two additional sites are being acquired as a widening of the RoW being purchased. The environmental effect of removal of vegetation is reversible through natural succession and replanting of appropriate native vegetation. However, within



the limits of clearing for highway asphalt surfaces and structures, the vegetation is assumed to be permanently removed, and this environmental effect is considered irreversible. Losses of AHF and rare vascular plants are minimal. No S1 species are lost.

It is likely that individuals of butternut, designated endangered by COSEWIC, will be lost due to site preparation activities. However, three rich hardwood stands (Figure 5.5.1-A, Appendix D), in which butternut was a dominant component of the tree canopy in at least two of these, have been avoided due to realignment of the Project. Also, AHF being purchased for conservation purposes contain the largest known population of butternut along the route. Loss of habitat or loss of individual trees are not regarded as threats to the butternut population (NBDNR unpublished). However, the potential loss of genetically resistant individuals may affect the long-term survival of this species in New Brunswick (NBDNR unpublished). The long-term viability of the population in the region will depend on the occurrence of individual trees that have resistance to the butternut canker. Mitigation for the loss of individual butternut in the Project footprint will include the collection of genetic material prior to construction of the Project. Therefore, the loss of individuals within the Project footprint will not likely result in a loss of genetically resistant individuals or the long-term survival of this species in New Brunswick.

Site specific EPP measures will be developed and implemented to protect AHF and rare plant concentrations proximal to the Project. This would include the delineation, surveying and flagging of rare plant locations to ensure minimum cutting occurs in these areas. AHF and rare vascular plants will be included in employee awareness training. Site preparation activities will be limited to within the Project footprint. Vehicles and equipment used during site preparation activities will use only designated roadways and access areas. Erosion protection measures are used to reduce or eliminate the removal of soil particles by flowing water. These measures will be placed on or applied to the soil surface and in conjunction with runoff control and sediment interception measures as appropriate. Various geomembranes and geotextiles will be used to minimize erosion as appropriate. In addition, revegetation with native vegetation will occur on slopes and embankments for long term stabilization.

Based on consideration of the potential environmental effects of the activities required for site preparation of the proposed TCH, the proposed mitigation (e.g., avoidance, EPP, EFG, and limited disturbance), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these activities are considered not significant.

Watercourse Crossing Structures

Mountain valerian was found along Big Presque Isle Stream on a steep stream bank near the high water mark (Figure 5.5.1 C, Appendix D). The plants were associated with shallow soil deposits at the base of bedrock outcrops. These areas are kept moist by groundwater seepage from the base of the steep slope



of the ravine through which the river flows. Protection measures that will be considered and reflected in site specific EPPs include flagging of the limits of clearing and at the top of slope in the vicinity of the population in order to avoid accidental trampling of the plants or unnecessary clearing of the vegetated buffer, and revegetation (as required) of recently cleared areas in the vicinity of the population. Protection measures for the population will be included in a site-specific environmental protection plan for the Big Presque Isle Stream crossing.

As outlined above for site preparation, NBDOT will follow their Sections 5.0 of the EPP and Sections 6.0 and 7.0 of the EFG for highway construction and erosion protection measures will be implemented. Based on consideration of the potential environmental effects of the activities and physical works required for watercourse crossing structures of the proposed TCH, the proposed mitigation (e.g., EPP, EFG, and site specific EPPs), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these activities are considered not significant.

Ancillary Structures and Facilities Construction

Mitigation measures will be implemented as described for site preparation. Any ancillary structures and facilities not currently identified that could require areas outside of the RoW and have not been surveyed will be subjected to a vascular plant survey.

Based on consideration of the potential environmental effects of the activities required for ancillary structures and facilities of the proposed TCH, the proposed mitigation (e.g., avoidance, EPP, EFG, and limiting area of disturbance), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these activities are considered not significant.

5.5.5.2.2 Operation

The following provides an evaluation of key potential project-VEC interactions for the operation phase of the Project as summarized in the environmental effects assessment matrix (Table 5.5.6). Operation of the proposed TCH will continue in perpetuity upon completion of the construction phase of the project. During operation of the proposed TCH, winter maintenance and the physical presence of the Project could result in a change in vegetation or habitat. The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects.



Table 5.5.6 Environmental Effects Assessment Matrix for Vegetation (Operation)

Environmental Effects Assessment Matrix						
Valued Environmental Component: <u>VEGETATION</u>						
Phase: <u>Operation</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Winter Safety	- Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Implement EPP and EFG - Develop long term salt management plan - Buffers/barriers for rare vascular plants as required - Design of watercourse crossings	1	4	1/2	R 2
Proposed TCH Presence	Change in habitat quality (A)	- Erosion control - Implement EPP and EFG	1	4	1/2	R 2
Key:						
Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation		Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ²		Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous		Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects.
		Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months		Reversibility: R = Reversible I = Irreversible		N/A = Not Applicable (A) = adverse (P) = positive

Winter Safety

Environment Canada (2001c) recently completed an assessment of road salt under *CEPA*. Recognizing that a total ban of road salt could potentially compromise human safety, the focus of road salt risk management is on implementation measures that optimize winter road maintenance practices so as to not jeopardize road safety while minimizing the potential environmental effects (Environment Canada 2001c). Therefore Environment Canada has categorized road salt as a Track 2 substance, requiring Life-Cycle Management. Management instruments to reduce the potential environmental effects of road salts are being developed through a national multi-stakeholder group (which involves representation from NBDOT) working in conjunction with Environment Canada. Proposed control measures will likely be presented in July of 2004. In accordance with Environment Canada's policy on road salt, all road agencies (e.g., NBDOT) must develop a Salt Management Plan. NBDOT is committed to developing best salt management practices in a continued effort to reduce the environmental effects of road salt on the environment. Currently Section 6.2.1 of the EPP identifies salt application protection measures.



Application rates identified in the Highway Maintenance Management System Field Manual (NBDOT 1992b) will be used to maximize the efficiency of salting and sanding and minimize the potential environmental effects.

At Big Presque Isle Stream and WC5 (tributary to Saint John River), run-off from the watercourse crossings will be redirected away from the rare plant locations.

A sufficient buffer will be maintained in areas where there is a potential for significant salt spray deposition on habitat near areas containing "May Be At Risk" or "Sensitive" vascular plant species. Based on the current Project footprint, however, there should be a sufficient buffer between most of the populations of these plants and the roadway to protect the plants from salt contamination, such that viable populations of these species should be unaffected by salt contamination.

Based on consideration of the potential environmental effects of the individual activities required for winter safety along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, salt management plan and buffers), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these activities are considered not significant.

Proposed TCH Presence

The long-term operation of the proposed TCH may create conditions that allow for erosion. Stabilization during construction and permanent erosion control measures will mitigate long-term environmental effects of erosion. Appropriate erosion control measures for each watercourse bank will be specified in site-specific environmental protection plans developed as part of the highway design. These will minimize the potential for stream bank destabilization and erosion. The presence of the highway is not expected to have a significant environmental effect on area plants due to runoff.

Based on consideration of the potential environmental effects of the individual activities required for the proposed TCH presence, the proposed mitigation (e.g., erosion control), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by the presence of the proposed TCH are considered not significant.

5.5.5.2.3 Accidents, Malfunctions and Unplanned Events

The following provides an evaluation of key potential project-VEC interactions for accidents, malfunctions and unplanned events as summarized in the environmental effects assessment matrix (Table 5.5.7). The issues related to vegetation are hazardous materials spills, erosion and sedimentation



control failures and fires. These accidents are possible during all Project phases. Further discussion of each accident type follows the table.

Table 5.5.7 Environmental Effects Assessment Matrix for Vegetation (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>VEGETATION</u> Phase: <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Materials Spills	- Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Implement EPP and EFG procedures, and provincial and federal regulations should be followed for storage and handling of materials - Contingency Plan - Employee training - Design highway for safe operation (RAD 120)	2	1	5/1	R	2
Erosion and Sedimentation Control Failure	- Change in habitat quality (A) - Loss of species of special conservation concern (A)	Implement EPP and EFG procedures	2	1	5/1	R	2
Fires	- Change in habitat quality (A) - Loss of species of special conservation concern (A)	- Implement EPP and EFG procedures, and follow provincial and federal regulations - Employee training	2	3	5/1	R	2
Key: Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Hazardous Materials Spills

Known hazardous materials that will be used during the construction and operation of the proposed TCH include fuels, lubricants, solvents, windshield washer and antifreeze. There is also a high probability that a large quantity of other various unidentified hazardous materials will be transported along this route. There is a possibility that these materials could be accidentally introduced into vegetation habitat



through a spill of these materials. The likelihood of a hazardous materials spill to occur and affect an entire population of rare vascular plants in the Assessment Area is low.

Employee awareness training will include the handling of hazardous materials. Section 4.19 of the EPP addresses hazardous materials issues. The design of the highway to RAD120 standards will reduce the likelihood of spills of hazardous materials due to accidents during the operation of the highway. NBDOT has spill response contingency procedures identified in Section 8.1 of the EPP and Section 5.7 of the EFG. The transportation of dangerous goods is strictly regulated in New Brunswick and Canada, and the regulatory spill response system is highly co-ordinated and effective.

The magnitude of the environmental effect of a spill would be dependent on a number of factors that are difficult to predict. However, given the mitigation in place, the magnitude of environmental effects attributable to these infrequent and unlikely accidents, malfunctions and unplanned events are likely to be low, and worst case medium. In the unlikely event of a hazardous material spill, the spilled material will be controlled and contained, and NBDOT will assist with the clean-up, as described in Section 5.4.5.2.4. Site-specific EPPs will be developed for work near environmentally sensitive areas and these will address preparedness measures that are necessary to ensure effective emergency response in the event of spills is reflective of the level of sensitivity.

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event, involving the release of a hazardous material into vegetation habitat along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these accidents are considered not significant.

Erosion and Sedimentation Control Failure

There is a potential during heavy precipitation events or flash floods for erosion control structures (e.g., check dams) to fail. To reduce the likelihood of these failures, protection measures will be followed as described in Section 4.5 of the EPP. Specifically, erosion control structures will be monitored regularly and maintained in a functional condition until the grass on seeded slopes is sufficiently established to be an effective erosion deterrent. During construction, all check dams will be inspected before and after each rainfall and at least daily during periods of prolonged rainfall. All check dams found to be damaged will be repaired immediately. Sediment deposits retained by structures will be removed when the level of sedimentation is within 100 mm of the top of the structure.

The potential for interactions between these failures and rare vascular plants will be reduced by not routing drainage channels in close proximity to rare plants. There are few instances where this type of event could result in the loss of species of special conservation concern.



Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event, involving the failure of erosion control structures along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these accidents are considered not significant.

Fires

The potential environmental effects of a fire in the Assessment Area could be severe. A forest fire could alter habitat quality, resulting in subsequent environmental effects on the population of species of special conservation concern and/or AHF. Fire within the Assessment Area of the highway could occur during any phase of the Project due to lightning or human activities. Factors influencing the severity and duration of environmental effects include time of year, extent of fire damage and type of fire (chemical, forest). Risk of forest fire along the road route is possibly higher than in non-road areas due to the presence of human activity along the road route, which may be recreational or commercial in nature.

The potential for Project-related fires during Construction and Maintenance will be mitigated through equipment maintenance (e.g., power saw mufflers and vehicle exhaust systems) and proper vigilance working with power equipment in forested areas, as per Section 8.4 of the EPP. Also, any burning of vegetative debris will require permits from NBDNR and NBDELG as per Section 4.8.3 of the EFG. All construction activities will be done in compliance with regulations contained within the *Forest Fires Act*.

During all construction activities, NBDOT inspectors will monitor clearing and other relevant operations to ensure equipment is functional and personnel are trained in its use.

Fire fighting services for the Perth-Andover to Woodstock region are located in Perth-Andover, Centreville, Lakeville, Florenceville, Bath, Glassville, Bristol, Hartland, Plaster Rock, Debec, Maliseet and Woodstock. The locations of these fire stations are close enough to provide adequate response to fires during operation of the proposed TCH. Mitigation measures during Operation are prevention oriented through vegetation management (regular mowing and brushing) as per Section 6.1.6 of the EPP to reduce the risk of fires from vehicles parked on the vegetation along the proposed TCH.

In the event of a fire occurring as a result of Construction or Maintenance activities, NBDOT personnel shall be prepared (i.e., will have access to round point shovel or fire extinguisher) to control and fight any fires in and about the work area, as per Section 7.4 and 8.4 of the EPP, and the *Forest Fires Act*. All fires will be reported to NBDNR. Forest fires not related to the Project will be managed by NBDNR.



Reversibility of physical environmental effects is high, but would occur over a number of years. Based on consideration of the potential environmental effects of an uncontrolled fire along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Vegetation by these accidents are considered not significant.

5.5.5.3 Determination of Significance

Table 5.5.8 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and vegetation, after taking into account any proposed mitigation. The table also considered the level of confidence of the study team in this determination and the likelihood of potential environmental effects.

Table 5.5.8 Residual Environmental Effects Summary Matrix for Vegetation

Residual Environmental Effects Summary Matrix Valued Environmental Component: VEGETATION				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	2	3
Maintenance	NS	3	1	3
Accidents, Malfunctions and Unplanned Events	NS	3	1	2
Project Overall	NS	3	2	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

All very rare vascular plant species (S1 and "May Be At Risk" species) and most populations of the other vascular plants of special conservation concern have been avoided through changes to the alignment. Several areas adjacent the RoW containing rich assemblages of vascular plant species of special conservation concern are being purchased by NBDOT for conservation purposes and future protection. Three of these areas are AHF not previously identified by MacDougall (1997). The protection of 72.2 ha of very high to high priority AHF should be considered more than adequate compensation for the loss of 6.8 ha of moderate priority sites (containing no rare vascular plant species) and a small proportion of populations of S2 to S3 plant species, by the Project. This AHF habitat, with its large number of vascular plant species of special conservation concern including the largest

population of the COSEWIC-listed butternut encountered along the RoW, would otherwise be at risk of future forest harvesting. The protection of two additional areas containing populations of two other vascular plant species of special conservation concern (showy lady's slipper and calypso) should also help protect the habitat from harvesting and development pressures.

The residual environmental effects are considered not significant for construction, operation and maintenance, and malfunctions, accidents and unplanned events, as viable populations of vascular plant species ranked S1 to S3, and "May Be At Risk" or "Sensitive" will remain following construction, and should remain during operation and maintenance of the proposed TCH, such that the long-term survival of these vascular plant species is not likely reduced within the Valley Lowlands Ecoregion, and there will not be a substantive loss of mature AHF as a result of the Project.

Overall, the residual environmental effects of the Project on Vegetation are considered not significant. Increased knowledge and protection of rare vascular plants and AHF in the area is a positive environmental effect that offsets some of the losses of individual plants.

5.5.6 Monitoring and Follow-up

NBDOT will undertake follow-up of rare plants that were observed within 50 m of the proposed RoW in the year following the completion of Construction and in the third year of operation. The follow-up will verify predictions made in the environmental assessment, and confirm the effectiveness of mitigation.





5.6 Wetlands

5.6.1 Rationale for Selection as Valued Environmental Component

Wetlands were selected as a VEC because of the potential for interactions between Project activities and wetland environments, and because of the relationship between wetlands and wildlife and other biological and physical environments. This is also in response to the Federal Government's goal for No Net Loss of wetland function (Environment Canada 1991).

In the context of the Wetlands VEC:

"Wetland" is defined per the New Brunswick *Clean Environment Act* as land that, either periodically or permanently, has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic process as indicated by the presence of hydric soils, hydrophytic vegetation and biological activities adapted to wet conditions; and

"Wetland function" is defined per the *Federal Policy on Wetland Conservation* as "...the natural processes and derivation of benefits and values associated with wetland ecosystems, including economic production (e.g., peat, agricultural crops, wild rice, peatland forest production), fish and wildlife habitat, organic carbon storage, water supply and purification (groundwater recharge, flood control, maintenance of flow regimes, shoreline erosion buffering), and soil and water conservation, as well as tourism, heritage, recreational, educational, scientific, and aesthetic opportunities" (Environment Canada 1991).

In this section, the environmental effects of the proposed Project activities on wetlands resulting from construction, operation, and maintenance as well as accidents, malfunctions and unplanned events are assessed.

5.6.2 Environmental Assessment Boundaries

5.6.2.1 Spatial and Temporal

The spatial boundaries (the "Assessment Area") for the assessment of the potential environmental effects of the Project on wetlands include all wetlands within 30 m of the proposed Project footprint, where activities associated with site preparation and construction, operation, and malfunctions and accidents of the proposed Project could potentially result in environmental effects on wetlands. For the purposes of this assessment, wetlands within the Project footprint for the proposed TCH are assumed to be permanently removed. The environmental effects of wetland loss and/or degradation are assessed within the context of the regional biogeoclimatic zone (i.e., the Valley Lowlands Ecoregion) and the alternative wetlands available within the zone.



The temporal boundaries of the proposed Project on the Wetlands VEC include the periods of construction, and subsequent operation and maintenance of the Project in perpetuity.

5.6.2.2 Administrative and Technical

Wetlands are protected through federal and provincial legislation and policy. Although there is no specific federal legislation regarding wetlands, they may be protected federally under the *Species at Risk Act (SARA)*, if they contain critical habitat for species at risk, the *Migratory Birds Convention Act, 1994 (MBCA)*, if they contain nests of migratory birds, and/or the *Fisheries Act*, if the wetland contributes to an existing or potential fishery. Details on the application of the *SARA* and the *MBCA* for protection of wildlife is provided in the Wildlife VEC, Section 5.7. Details on the application of the *Fisheries Act* for the protection of fish and fish habitat is provided in the Fish and Fish Habitat VEC, Section 5.4.

Wetland conservation is federally promoted by the *Federal Policy on Wetland Conservation* (Environment Canada 1991). The objective of this policy is to "promote the conservation of Canada's wetlands to sustain their ecological and socio-economic function, now and in the future." Coordination of implementation of the policy is the responsibility of Environment Canada, specifically the Canadian Wildlife Service (CWS) and the Environmental Conservation Branch (ECB).

Wetlands are addressed provincially by the *New Brunswick Wetlands Conservation Policy* (NBDNRE and NBDELG 2002). The primary objective of this policy is to prevent the loss of provincially significant wetlands and achieve no net loss of wetland functions for all other wetlands (i.e., wetlands greater than 1 ha in size). Implementation of this policy is the responsibility of NBDNR, through existing legislation (below).

Wetlands are protected provincially by the *Clean Water Act* and the *Clean Environment Act*. Under the *Clean Water Act*, a permit is required for a wetland alteration. Both of these acts are administered by the NBDELG. The *Clean Environment Act* includes provisions to designate a wetland or any portion of it as a protected area. Under the *Clean Water Act*, the *Watercourse and Wetland Alteration Regulation* applies to all wetlands of 1 ha or greater in size, or any wetland contiguous to a watercourse. The application process applies to all activities (construction, clearing and excavation, including construction and maintenance of watercourse crossings) within 30 m of a wetland. Watercourse crossings will be installed according to the *Watercourse Alteration Technical Guidelines* developed by NBDELG (2002b). In addition, all watercourse crossings of more than 1.2 m in diameter and/or more than 25 m in length, and/or with a slope above 0.5% will follow the *Guidelines for the Protection of Fish and Fish Habitat – The placement and Design of Large Culverts* (DFO 1999a).

Existing information used in support of the assessment of wetlands was obtained from the New Brunswick Wetland Atlas (CWS 1987), the Atlantic Canada Conservation Data Centre (ACCDC),



CWS, Ducks Unlimited (DU), NBDNR and their forest and wetland inventory mapping, orthographic maps and aerial photography (1:6000; 1999). The baseline Assessment Area for wetlands includes the proposed Project footprint and the immediate habitat within 30 m, where activities associated with site preparation and construction, operation, and accidents, malfunctions and unplanned events of the proposed Project could potentially result in environmental effects on wetlands. Knowledge of the wetlands affected by the proposed Project is based on wetland habitat surveys conducted in 2002, supplementary surveys in 2003 and other information provided by the above sources, and the professional judgement of the study team. Wetland habitat surveys were carried out at each of the wetlands to be crossed for the proposed TCH between Perth-Andover and Woodstock in 2002 to provide a current and thorough examination of baseline conditions. The proposed TCH route was divided into three sections and the surveys were conducted by three teams (Dillon 2003; ACER 2003; JWEL 2003a). If there was a realignment affecting a wetland, the need for additional wetland surveys was examined and executed as required in 2003.

Communications with First Nations people are ongoing, and a traditional ecological knowledge (TEK) study will be conducted in support of the Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons VEC. This TEK study is not yet complete, but may contain information regarding use of wetlands resources (e.g., fish and wildlife) by First Nations people within the Assessment Area.

It is the professional judgement of the study team that the data that are currently available to characterize the existing conditions and the existing knowledge regarding the Project-VEC interactions are sufficient to support the environmental assessment.

5.6.3 Residual Environmental Effects Rating Criteria

A *significant adverse residual environmental effect* occurs when there is a net loss of wetland functions in a wetland of "significant value" as determined following an evaluation of wetland function.

5.6.4 Existing Conditions

A total of 24 wetlands and wetland complexes are found within 30 m of the proposed Project footprint (Figure 5.6.1 A-D, Appendix E). The wetlands range in size from less than 1 ha to 21 ha. Wetland evaluations were conducted on each of the wetlands identified.

5.6.4.1 Methodology

The proposed TCH route was divided into three sections and the surveys were conducted by three teams (Dillon 2003; ACER 2003; JWEL 2003a). Wetland habitat surveys were completed along the proposed



alignment from Woodstock to Perth-Andover. The baseline Assessment Area for wetlands includes the anticipated footprint within the proposed alignment and the immediate habitat within 30 m. Additional wetland habitat surveys were completed by JWEL in 2003 to cover new wetlands that are located within 30 m of the adjusted alignment from Big Presque Isle Stream to Raymond Road (St. Thomas).

Existing information used in support of the assessment of wetlands was obtained from the New Brunswick Wetland Atlas (CWS 1987), the ACCDC, CWS, Ducks Unlimited (DU), NBDNR and their forest and wetland inventory mapping, orthographic maps and aerial photography (1:6000; 1999). During the field surveys, information required to complete a wetland evaluation was compiled. This included information regarding the likely or observed function of the wetland as wildlife habitat, as habitat for rare or endangered species, as a regulator of surface water flow, as a water treatment system, or as a socio-economic resource. This information was supplemental with vascular plant surveys conducted by JWEL in 2003.

As the first step outlined in *The Federal Policy on Wetland Conservation Implementation Guide for Federal Land Managers* (Environment Canada 1996), wetland evaluations were completed on all wetlands identified within 30 m of the proposed Project footprint to determine the "significance" of each wetland. The *New Brunswick Wetlands Conservation Policy* (NBDNRE and NBDELG 2002) applies to all wetlands greater than 1 ha in size. Therefore, wetland evaluations to determine wetland "significance" were evaluated using two processes. Wetlands of 1 ha or smaller in size were evaluated using a version of 10-step evaluation method for wetlands under 2 ha developed for the Nova Scotia Department of Environment Wetlands Directive. Wetlands larger than 1 ha in size were evaluated using a modified Stage Two "Detailed Analysis" detailed in the North American Wetlands Conservation Council (Canada) *Wetland Evaluation Guide* (Bond *et al.* 1992).

Freshwater wetlands in New Brunswick have been evaluated by CWS (1987) using Golet's classification (Golet 1973) and evaluation system to rank wetlands based on an evaluation with respect to wildlife value. The rank is achieved through an evaluation of dominant vegetation, topography, depth of water and proportion and interspersed cover and water (Golet 1973). The 1987 CWS evaluations were completed based on 1980-1985 aerial photography (CWS 1987). Wetlands with a score greater than 65 are considered productive wetlands (Golet 1973). The Golet score was taken into consideration during the wetland evaluations, however, due to the potential for substantial changes in wetlands since the CWS evaluations, and the identification of wetlands that were not evaluated in 1987, all wetlands were re-evaluated for wildlife value.

The Canada Land Inventory (CLI) provides a national classification system that rates the capability of land to support wildlife (Environment Canada 1970). The CLI for wildlife is restricted to two main groups of wildlife: ungulates and waterfowl. The classification is based on characteristics such as soil, moisture, fertility, landform, climate and vegetation and also assumes good wildlife management



practices are implemented (Environment Canada 1970). The CLI was taken into consideration in some of the wetland evaluations, where they were provided by the baseline studies authors (*i.e.*, Dillon 2003, and ACER 2003).

Species of special conservation concern recorded in the wetlands were ranked according to the criteria provided in Table 5.5.1 in Section 5.5.3.

5.6.4.2 Wetlands 1 Hectare or Smaller in Size

A total of 11 wetlands smaller than 1 ha in size were recorded in the Assessment Area. Each of these wetlands is described below and was evaluated using the 10-step evaluation process of the Nova Scotia Department of Environment Wetlands Directive. Completed wetland evaluations are provided in Appendix E.

Wetland 1 (WL1)

WL1 is a 0.5 ha wetland complex comprising kettle marsh and a coniferous treed basin swamp located north of Demerchant Brook (Figure 5.6.1 A, Appendix E). The wetland was once partially surrounded by agricultural land. Household rubbish was previously discarded in the wetland. A vegetation survey revealed the presence of 58 species of vascular plants, none of which are considered to be rare in New Brunswick. No wildlife species of special conservation concern were observed in the wetland.

The western edge of the proposed Project footprint will cross the eastern edge of WL1. Approximately 0.09 ha will be directly affected by Project-related clearing and construction activities.

Wetland 2 (WL2)

WL2 is a 0.07 ha terminal basin marsh located at the head of an unnamed tributary to Brown Brook (Figure 5.6.1 A, Appendix E). A vegetation survey revealed the presence of 19 species of vascular plants, including small yellow water-crowfoot (*Ranunculus gmelinii* var. *purshii*), which is ranked S2 in New Brunswick (ACDC 2003), but is considered "Secure" by NBDNRE (2002a). No wildlife species of special conservation concern were observed in the wetland.

The proposed Project footprint will cross through the entire area (0.07 ha) of WL2.

Wetland 4 (WL4)

WL4 is a 0.03 ha stream marsh located at the base of a newly constructed beaver dam on the banks of an unnamed tributary to Graham Brook, south of Bishop Lake (Figure 5.6.1 A, Appendix E). A vegetation survey revealed the presence of 47 species of vascular plants, none of which is considered to be rare in



New Brunswick (Hinds 2000; ACCDC 2003; NBDNRE 2002a). The wetland is not good habitat for amphibian species using ephemeral/vernal pool habitat due to the presence of brook trout. No birds were noted, however, the beaver pond upstream of the wetland could be marginally suitable for waterfowl use during migration. No wildlife species of special conservation concern were observed in the wetland.

WL4 will be crossed by the proposed Project footprint and is expected to be affected by the removal of the beaver dam and installation of culverts at this location.

Wetland 5 (WL5)

WL5 is a 0.4 ha terminal basin marsh located north of Scott Road (Figure 5.6.1 A, Appendix E). A vegetation survey revealed the presence of 41 species of vascular plants, including Canada clearweed (*Pilea pumila*), which is ranked S2 in New Brunswick (ACCDC 2003), and is considered "Sensitive" by NBDNRE (2002a). No wildlife species of special conservation concern were observed in the wetland.

The wetland is located approximately 50 m west of the proposed Project footprint. WL5 will not be directly affected by the proposed Project.

Wetland 6 (WL6)

WL6 is a 0.8 ha stream marsh (beaver meadow) located on Graham Brook (Figure 5.6.1 A, Appendix E). The area was formerly flooded as a result of beaver activity. Beaver activities have ceased and the stream marsh has developed on the bottom of the old beaver pond. A vegetation survey revealed the presence of 83 species of vascular plants, one of which (tufted loosestrife (*Lysimachia thyrsiflora*)) is considered to be uncommon in New Brunswick (ACCDC 2003) but considered "Secure" by NBDNR (NBDNRE 2002a). No rare (S1, S2), "at risk", "May Be At Risk", or "Sensitive" plants were recorded in the wetland. Open water at the western end of the wetland provides relatively good waterfowl habitat. No wildlife species of special conservation concern were observed in the wetland.

The proposed Project footprint will cross WL6. Approximately 0.70 ha of the wetland will be directly affected by the proposed Project.

Wetland 7 (WL7)

WL7 is a 0.09 ha terminal basin marsh located between Scott Road and Dean Road, south of Graham Brook (Figure 5.6.1 A, Appendix E). A vegetation survey revealed the presence of 23 species of vascular plants, including Canada clearweed. No wildlife species of special conservation concern were observed in the wetland.



WL7 is located approximately at the edge of the proposed Project footprint and therefore will be largely outside the proposed Project footprint.

Wetland 8 (WL8)

WL8 is a 0.5 ha terminal basin marsh located at the head of an unnamed tributary to Graham Brook (Figure 5.6.1 A, Appendix E). A vegetation survey revealed the presence of 36 species of vascular plants, including Canada clearweed. No wildlife species of special conservation concern were observed in the wetland. A deer blind indicates hunting in the area.

WL8 will be crossed by the proposed Project footprint on the west side of the wetland. Approximately 0.36 ha of the wetland will be directly affected by the proposed Project.

Wetland 10 (WL10)

WL10 is a 0.47 ha seasonally flooded emergent wetland located south of Route 560 (Figure 5.6.1 B, Appendix E). The wetland consisted of saturated muddy substrate at the time of the survey. Ground vegetation consisted of dead *Equisetum* (horsetail) plants. No rare plants or wildlife species of special conservation concern were observed in the wetland.

Due to modifications of the alignment near this wetland, the wetland is located approximately 50 m from the edge of the Project footprint.

Wetland 21 (WL21)

WL21 is a 0.45 ha seasonally flooded emergent wetland located on Lanes Creek (Figure 5.6.1 D, Appendix E) and is impounded by a beaver dam. Greater than 95% of the wetland is covered in vegetation. The wetland is surrounded by agricultural land and softwood stands. No rare plants or wildlife species of special conservation concern were observed in the wetland.

WL21 will be crossed by the proposed Project footprint through the west side of the wetland. Approximately 0.23 ha of the wetland will be directly affected by the proposed Project.

Wetland 22 (WL22)

WL22 is a 0.15 ha seasonally flooded emergent wetland located in an isolated depression along an unnamed tributary to Harper Brook (Figure 5.6.1 D, Appendix E). Greater than 95% of the wetland is covered in vegetation. The wetland is surrounded by agricultural land and immature and mature



hardwood stands. No rare plants or wildlife species of special conservation concern were observed in the wetland.

All of WL22 will be directly affected by the proposed Project.

Wetland 23 (WL23)

WL23 is a 0.25 ha seasonally flooded shrub wetland located in an isolated depression at the head of an unnamed tributary to Harper Brook (Figure 5.6.1 D, Appendix E). Greater than 95% of the wetland is covered in vegetation. The wetland is surrounded by agricultural land and mixedwood forest stands. A high tension power line RoW runs through the eastern third of the wetland. No rare plants or wildlife species of special conservation concern were observed in the wetland.

All of WL23 will be directly affected by the proposed Project.

5.6.4.2.1 Summary of Wetlands 1 Hectare or Smaller in Size

Some of these small wetlands may be used as thermal refugia by black bear and moose during hot periods in the summer; however, this type of habitat is not limited in the general area. Most of the wetlands also provide breeding habitat for a variety of amphibian species, none of which are considered to be rare in New Brunswick.

None of the wetlands have a Golet score of greater than 65. Generally, the land in the Assessment Area has a CLI classification of 2 for ungulates and 7 for waterfowl. The classification of 2 for ungulates indicates that the land has "very slight limitations to the production of ungulates" (Environment Canada 1970). The classification of 7 for waterfowl indicates that the land has "such severe limitations that almost no waterfowl are produced" (Environment Canada 1970).

Overall the wetlands appear to have low social/cultural value. None of them are part of any protected area such as a national or provincial park, national wildlife area, federal migratory bird sanctuary, ecological reserve, provincial wildlife management area, wildlife refuge, or game sanctuary.

A summary of each of the wetlands smaller than 1 ha is provided in Table 5.6.1.



Table 5.6.1 Summary of Wetlands < 1 ha in Size Located Within 30 m of the Project Footprint

Wetland Number	Wetland Identifier	Wetland Area (ha)	Wetland Type	Relationship to proposed Project Footprint	Area Affected (ha)
WL1	JW6	0.5	Kettle marsh/basin swamp complex	Project footprint through eastern edge of wetland.	0.09
WL2	JW8	0.07	Terminal basin marsh	Project footprint through entire wetland.	0.07
WL4	JW4	0.03	Stream marsh	Project footprint through middle of wetland.	0.03
WL5	JW7	0.4	Terminal basin marsh	Project footprint located to the east of wetland.	0
WL6	JW3	0.8	Stream marsh	Project footprint through middle of wetland.	0.70
WL7	JW2	0.09	Terminal basin marsh	Project footprint skirts east side of wetland.	0.001
WL8	JW1	0.5	Terminal basin marsh	Project footprint through west side of wetland.	0.36
WL10	ACER2	0.47	Seasonally flooded flats	Project footprint located to the west of wetland.	0
WL21	D-F103	0.45	Stream marsh	Project footprint through west side of wetland.	0.23
WL22	D-F102	0.15	Stream marsh	Project footprint through west side of wetland.	0.15
WL23	D-F101	0.25	Shrub swamp	Project footprint through east side of wetland.	0.25

The 10-step evaluation process evaluates the "significance" of a wetland based on the following functions:

- wildlife habitat potential (e.g., Golet score greater than 65);
- rare and endangered species;
- groundwater recharge potential;
- role of the wetland in surface flow regulation;
- agricultural use of the wetland;
- role of the wetland in water treatment; and
- potential for peat development.

Although all of the wetlands may support some wildlife, none had a Golet score greater than 65. Four of the wetlands have rare or uncommon plant species, however, based on discussions with NBDNR regarding these wetlands, none would be considered provincially "significant" (L. Swanson and M. Toner, pers. comm. 2003). The small yellow water-crowfoot is considered to be "Secure" by NBDNR (NBDNRE 2002a). As discussed in Section 5.5, Canada clearweed was recorded in 16 sites within the Assessment Area. Given the small size of the wetlands containing Canada clearweed, and the abundance and distribution of this species in the Assessment Area, these wetlands are not considered to be "significant" for rare and endangered species.



None of the wetlands were considered "significant" for groundwater recharge potential, role of the wetland in surface flow regulation, agricultural use of the wetland, role of the wetland in water treatment, and/or potential for peat development. The conclusion of all of the wetland evaluations (Appendix E) was that none of the wetlands smaller than 1 ha are considered "significant" wetlands.

5.6.4.3 Wetlands Larger Than 1 Hectare in Size

A total of 13 wetlands larger than 1 ha in size were recorded in the Assessment Area. Each of these wetlands is described below and was evaluated using the Stage Two "Detailed Analysis" of the North American Wetlands Conservation Council (Canada) Wetland Evaluation Guide (Bond *et al.* 1992).

Wetland 3 (WL3)

Wetland 3 is a 6.7 ha wetland complex comprising shore marsh, shore bog, coniferous treed shore swamp and open water. Two critical habitat values and one critical ecological value were confirmed in WL3.

Rare animal and plant species are present. Three rare vascular plant species were recorded in the wetland. Lesser bladderwort (*Utricularia minor*), ranked S2 by ACCDC (2003) and considered "Sensitive" by NBDNRE (2002a), was recorded in Wetland 3 and is expected to be found throughout the wetland in suitable habitat. Small yellow water-crowfoot (*Ranunculus gmelinii* var. *purshii*) is ranked S2 in New Brunswick (ACCDC 2003), but is considered "Secure" by NBDNRE (2002a) and may in future be ranked as S3. This species was recorded at five locations within the RoW. Given the apparent status of this species, the loss of this small wetland will not likely have an adverse effect on the local or regional populations. Small-fruited burreed (*Sparganium natans*) is ranked as rare or borderline rare (S2 or S2S3) by ACCDC (2003) and considered "Secure" by NBDNRE (2002a) and was found with lesser bladderwort. Like the lesser bladderwort, this species is expected to be found throughout the wetland in suitable habitat. A breeding bird survey was conducted at Wetland 3 in 2003, and one S4 (ACCDC 2003), "Sensitive" (NBDNRE 2002a) species, purple finch (*Carpodacus purpureus*), was recorded.

The wetland has a Golet score of 67, an accepted wetland evaluation system. Wetlands with a Golet score greater than 65 are considered productive wetlands for wildlife. The Golet score of 67 for WL3 was likely based on the wetland's potential for waterfowl production and as loafing and feeding habitat for migrating waterfowl. Also, the land in the Assessment Area generally has a CLI classification of 2 for ungulates.

The wetland also displays biological diversity that is of interest. Overall the wetland is rich in species flora as well as diversity of local habitats.



Although marginally considered a significant wetland, only a small proportion (<5%) of the wetland, in the most recently flooded portion at the extreme upgradient end, is located within the proposed footprint of the Project. With appropriate drainage controls and maintenance of wetland hydrology, the project is not likely to have a significant environmental effect on the wetland.

Wetland 9 (WL9)

WL9 is a 6.4 ha deep marsh wetland located on an unnamed tributary to Upper Guisiguit Brook (Figure 5.6.1 B, Appendix E). A beaver dam is located at the wetland outlet in the southern end of the wetland, creating open water. The wetland is covered by dead woody and emergent vegetation. The northern end contains dead cedars, grasses and mosses. No rare plant species were recorded in the wetland. Purple finch (S4B, "Sensitive") were observed in the wetland.

The proposed Project footprint will pass through the western side of the wetland. Approximately 4.3 ha of the wetland will be directly affected by the proposed Project.

Wetland 11 (WL11)

WL11 is a 13.3 ha emergent vegetated deep marsh wetland complex located on an unnamed tributary to Lower Guisiguit Brook (Figure 5.6.1 B, Appendix E). A beaver dam is located at the wetland outlet in the southern end of the wetland, creating open water. The wetland is primarily a wet meadow with open water and a swampy beaver pond. Approximately 85% of the wetland complex is covered by vegetation. A vegetation survey revealed the presence of lesser bladderwort (S2, "Sensitive") and two species (hidden-scaled sedge (*Carex cryptolepis*) and lesser tussock sedge (*Carex diandra*)) which are ranked S3 (ACCDC 2003) and "Secure" (NBDNRE 2002a). No wildlife species of special conservation concern were recorded in the wetland.

The proposed Project footprint will pass through the southern end of the wetland. Approximately 0.64 ha of the wetland will be directly affected by the proposed Project.

Wetland 12 (WL12)

WL12 is a 14.1 ha compact shrub swamp located on Lower Guisiguit Brook (Figure 5.6.1 B, Appendix E). An abandoned beaver pond has drained down and the area consists of grasses, alders and cedars. Greater than 95% of the wetland is covered by vegetation. No rare plant species were recorded in the wetland. Purple Finch (S4, "Sensitive") were observed in the wetland.

The proposed Project footprint will pass through the northern end of the wetland. Approximately 0.74 ha of the wetland will be directly affected by the proposed Project.



Wetland 13 (WL13)

WL13 is a 5.54 ha shrub swamp located on an unnamed tributary to Lower Guisiguit Brook (Figure 5.6.1 B, Appendix E). A beaver pond is associated with the wetland, creating open water. Greater than 95% of the wetland is covered by vegetation. No rare plant species or wildlife of special conservation concern were recorded in the wetland.

The proposed Project footprint will pass through the western side of the wetland. Approximately 2.7 ha of the wetland will be directly affected by the proposed Project.

Wetland 14 (WL14)

WL14 is a 4.5 ha shallow marsh located on the headwaters of Lower Guisiguit Brook (Figure 5.6.1 B, Appendix E). A beaver pond is associated with the wetland, creating open water. Approximately 85% of the wetland is covered by vegetation. No rare plant species were recorded in the wetland. Purple Finch (S4, "Sensitive") and Great-crested Flycatcher, ranked as S4 by ACCDC (2003) and considered "Sensitive" by NBDNR (2003a), were observed in the wetland.

The proposed Project footprint will pass through the middle of the wetland. Approximately 3.8 ha of the wetland will be directly affected by the proposed Project.

Wetland 15 (WL15)

WL15 is an 11.3 ha shrub swamp located around Leith Lake (Figure 5.6.1 B, Appendix E). Greater than 95% of the wetland is covered by vegetation. The wetland vegetation consists of mosses, grasses, cedars and black spruce. No rare plant species were recorded in the wetland. Purple Finch (S4, "Sensitive"), Great-crested Flycatcher (S4, "Sensitive") and, Willow Flycatcher, ranked as S1S2 by ACCDC (2003) and considered "Sensitive" by NBDNR (2003a), were observed in the wetland.

The proposed Project footprint will pass through the upland portion of the wetland, which is mostly saturated soils with grass, shrubs and some trees. Approximately 1.2 ha of the wetland will be directly affected by the proposed Project.

Wetland 16 (WL16)

WL16 is a 6 ha wetland complex comprising seasonally flooded shrub swamp located on an unnamed tributary to Hunters Brook (Figure 5.6.1 C, Appendix E). The wetland complex is surrounded by cultivated agricultural land, stands of mixed wood, regenerating clear-cuts, developed land, rural road



and highway. No rare plant species or wildlife of special conservation concern were recorded in the wetland.

WL16 is crossed by the proposed Project footprint on the west side of the wetland. Approximately 1.0 ha of the wetland will be directly affected by the proposed Project.

Wetland 17 (WL17)

WL17 is a 2.3 ha mixed wood treed basin swamp. The wetland is located south of Dryer Road (Figure 5.6.1 C, Appendix E). The wetland is a marginal swamp area interspersed with upland patches. The wetland receives overland surface flow mostly in the spring, and some possible inputs of groundwater. No outflow was obvious. A vegetation survey revealed the presence of 82 species of vascular plants, none of which is considered to be rare in New Brunswick (ACCDC 2003; NBDNRE 2002a). No wildlife species of special conservation concern were observed in the wetland.

The proposed Project footprint will pass through most of the wetland on the eastern side. Approximately 1.6 ha of the wetland will be directly affected by the proposed Project.

Wetland 18 (WL18)

WL18 is a 12.3 ha wetland complex comprising treed basin swamp, raised treed bog, treed bog and open low shrub bog. The wetland is located south of Dryer Road (Figure 5.6.1 C, Appendix E). A vegetation survey revealed the presence of 86 species of vascular plants. Boreal bog sedge (*Carex magellanica* subsp. *magellanica*), which is ranked S2 (ACCDC 2003) and considered to be "Sensitive" (NBDNRE 2002a), was found scattered throughout the swamp near the edge of the bog. No wildlife species of special conservation concern were observed in the wetland. The wetland is an interesting wetland complex containing one of a few true acidic bog habitats identified in the Assessment Area.

The proposed Project footprint will pass along the edge of the western side of the wetland. Approximately 1.5 ha of the shrub swamp wetland will be directly affected by the proposed Project. The swamp area containing boreal bog sedge, and the bog proper will not be directly affected by the proposed Project.

Wetland 19 (WL19)

WL19 is a 3.4 ha, seasonally flooded shrub swamp located on an unnamed tributary to the Little Presque Isle River (Figure 5.6.1 D, Appendix E). The wetland is impounded by a beaver dam. The wetland is surrounded by softwood and mixed wood stands of various ages. Approximately 12% of the wetland perimeter is surrounded by a regenerating clear-cut and agricultural land is located within 60 m to the



north and west. Greater than 95% of the wetland is covered in vegetation. No plant species of special conservation concern were recorded in the wetland. Virginia Rail (S3, "Sensitive") was observed in the wetland.

The proposed Project footprint will pass through the west side of the wetland. Approximately 0.31 ha of the wetland will be directly affected by the proposed Project.

Wetland 20 (WL20)

WL20 is a 21 ha, seasonally flooded shrub swamp located on the Little Presque Isle Stream (Figure 5.6.1 D, Appendix E). The wetland is partially impounded by a beaver dam and the remains of a deteriorated anthropogenic dam. The wetland is surrounded by cultivated agricultural land (76%) and a narrow band of regenerating cutover areas adjacent to cultivated agricultural land (24%). Greater than 95% of the wetland is covered in vegetation. No rare plant species or wildlife of special conservation concern were recorded in the wetland.

The wetland has been assigned a Golet score of 66. The proposed Project footprint will pass through near the middle of the wetland. Approximately 1.4 ha of the wetland will be directly affected by the proposed Project, however, given that Little Presque Isle Stream will be crossed with a bridge structure, the footprint of disturbance should be limited to the bridge pier, depending on the final design and spanning limitations.

Wetland 24 (WL24)

WL24 is 5 ha, a permanently flooded aquatic bed located on an unnamed tributary to the Meduxnekeag River (Figure 5.6.1 D, Appendix E). The wetland is impounded by the existing TCH with a water control structure on the upstream end of the culvert. The wetland consists largely of open water. The wetland is hydrologically connected to a wetland on the west side of the TCH. The wetland is surrounded by cultivated agricultural land (45%), a narrow band of mixed wood adjacent to cultivated agricultural land (45%) and the existing TCH along the western perimeter (10%). Approximately 25% of the wetland is covered in vegetation. No plant or wildlife species of special conservation concern were recorded in the wetland.

The proposed Project footprint crosses WL24 on the west side of the wetland. Approximately 0.54 ha of the wetland will be directly affected by the proposed Project, involving the twinning of the adjacent section of the TCH.



5.6.4.3.1 Summary of Wetlands Larger Than 1 Hectare in Size

Most of the wetlands may be used as thermal refugia by black bear and moose during hot periods in the summer; however, this type of habitat is not limited in the general area. Most of the wetlands also provide breeding habitat for a variety of amphibian species, none of which are considered to be rare in New Brunswick.

Three of the wetlands have a Golet score of greater than 65. Generally, the land in the Assessment Area has a CLI classification of 2 for ungulates and 7 for waterfowl. The classification of 2 for ungulates indicates that the land has "very slight limitations to the production of ungulates" (Environment Canada 1970). The classification of 7 for waterfowl indicates that the land has "such severe limitations that almost no waterfowl are produced" (Environment Canada 1970). Wetland 11 is classified as class 4 for waterfowl, indicating that it has only moderate limitations to the production of waterfowl.

Overall the wetlands appear to have low social/cultural value. None of them are part of any protected area such as a national or provincial park, national wildlife area, federal migratory bird sanctuary, ecological reserve, provincial wildlife management area, wildlife refuge, or game sanctuary.

A summary of each of the wetlands larger than 1 ha is provided in Table 5.6.2.

Table 5.6.2 Summary of Wetlands > 1 ha in Size Located Within 30 m of the Project Footprint

Wetland Number	Wetland Identifier	Wetland Area (ha)	Wetland Type	Relationship to proposed Project Footprint	Area Affected (ha)
WL3	JW5	6.7	Shore marsh/shore bog/shore swamp/open water complex	Project footprint through northeastern end of wetland.	0.32
WL9	ACER1	6.4	Deep marsh	Project footprint through west side of wetland.	4.3
WL11	ACER3	13.3	Deep marsh	Project footprint through southern end of wetland.	0.64
WL12	ACER4	14.1	Shrub swamp	Project footprint through northwest side of wetland.	0.74
WL13	ACER4A	5.5	Shrub swamp	Project footprint through west side of wetland.	2.7
WL14	ACER5	4.5	Shallow marsh	Project footprint through middle of wetland.	3.8
WL15	ACER6	11.3	Shrub swamp	Project footprint through west side of wetland.	1.2
WL16	5222 5219 5217	6	Shrub swamp complex	Project footprint through west side of wetland.	1.0
WL17	JW1-new	2.3	Treed basin swamp	Project footprint through eastern side of wetland.	1.6
WL18	JW2-new	12.3	Treed basin swamp/treed bog/shrub bog complex	Project footprint through western edge of wetland.	1.5
WL19	1992	3.4	Shrub swamp	Project footprint through west end of wetland.	0.31
WL20	1143	21	Shrub swamp	Project footprint through middle of wetland.	1.4
WL24	9441	5	Open water	Project footprint through west end of wetland.	0.54



Through the Stage Two "Detailed Analysis" process of the North American Wetlands Conservation Council (Canada) Wetland Evaluation Guide (Bond *et al.* 1992), wetlands are evaluated for the following values:

- Life Support Values – hydrological values, biogeochemical values, habitat values and ecological values;
- Social/Cultural Values – aesthetic values, recreational values, education and public awareness values, public status values, and cultural attribute values; and
- Wetland Production Values – agricultural values, renewable resource values, non-renewable resource values, tourism and recreational values and urban values.

The Stage Two evaluates the "significance" of a wetland based on "critical values". A critical value is defined as "...a wetland value whose product, service or function is very important to society or where an important threshold or function may be exceeded, resulting in the loss of the function and value" (Bond *et al.* 1992).

A wetland is considered "significant" if three or more critical values are identified for the wetland and/or over 50% of the values identified for the wetland have national/provincial/regional significance (Bond *et al.* 1992).

The conclusion of all of the wetland evaluations (Appendix E) was that only one of the wetlands is considered "significant". WL3 had three critical values identified. None of the wetlands had more than 50% of the values having national, provincial and/or regional significance.

Wetland 3 is a 6.7 ha wetland complex comprising shore marsh, shore bog, coniferous treed shore swamp and open water. Two critical habitat values and one critical ecological value were confirmed in WL3.

Rare animal and plant species are present. Three rare vascular plant species were recorded in the wetland. Lesser bladderwort (*Utricularia minor*), ranked S2 by ACCDC (2003) and considered "Sensitive" by NBDNRE (2002a), was recorded in Wetland 3 and is expected to be found throughout the wetland in suitable habitat. Small yellow water-crowfoot (*Ranunculus gmelinii* var. *purshii*) is ranked S2 in New Brunswick (ACCDC 2003), but is considered "Secure" by NBDNRE (2002a) and may in future be ranked as S3. This species was recorded at five locations within the RoW. Given the apparent status of this species, the loss of this small wetland will not likely have an adverse effect on the local or regional populations. Small-fruited burreed (*Sparganium natans*) is ranked as rare or borderline rare (S2 or S2S3) by ACCDC (2003) and considered "Secure" by NBDNRE (2002a) and was found with lesser bladderwort. Like the lesser bladderwort, this species is expected to be found throughout the wetland in suitable habitat. A breeding bird survey was conducted at Wetland 3 in 2003, and one S4



(ACCDC 2003), "Sensitive" (NBDNRE 2002a) species, purple finch (*Carpodacus purpureus*), was recorded.

The wetland has a Golet score of 67, an accepted wetland evaluation system. Wetlands with a Golet score greater than 65 are considered productive wetlands for wildlife. The Golet score of 67 for WL3 was likely based on the wetland's potential for waterfowl production and as loafing and feeding habitat for migrating waterfowl. Also, the land in the Assessment Area generally has a CLI classification of 2 for ungulates.

The wetland also displays biological diversity that is of interest. Overall the wetland is rich in species flora as well as diversity of local habitats.

Although marginally-considered a significant wetland, only a small proportion (<5%) of the wetland, in the most recently flooded portion at the extreme upgradient end, is located within the proposed footprint of the Project. With appropriate drainage controls and maintenance of wetland hydrology, the project is not likely to have a significant environmental effect on the wetland.

As part of the initial constraint analysis and selection of the preferred alignment during the early planning, wetlands are one of the constraints that NBDOT attempts to avoid (Section 3.1.2 of EPP). Given the number of constraints in this area of New Brunswick, some wetlands could not be avoided, without potentially causing significant environmental effects on other VECs, or compromising the design standard of the proposed Project.

5.6.5 Environmental Effects Analysis

5.6.5.1 Project-VEC Interactions

Table 5.6.3 provides a summary of the potential environmental effects resulting from the Project-VEC interactions, including those of past, present and likely future projects. The table is divided according to each of the Project phases assessed (construction, operation and maintenance), as well as malfunctions, accidents and unplanned events. The discussion following the table provides an analysis of key Project-VEC interactions, by Project phase.



Table 5.6.3 Project Activity – Environmental Effects Interaction Matrix for Wetlands

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>WETLANDS</u>			
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects		
	Change in Wetland Quantity	Change in Wetland Quality	Loss of Wetland Function
Construction			
Site Preparation	✓	✓	✓
Roadbed Preparation	✓	✓	✓
Surfacing and Finishing		✓	
Watercourse Crossing Structures	✓	✓	✓
Ancillary Structures and Facilities Construction	✓	✓	✓
Operation			
Winter Safety		✓	✓
Proposed TCH Presence		✓	
Maintenance			
Proposed TCH Maintenance		✓	✓
Vegetation and Wildlife Management		✓	
Accidents, Malfunctions and Unplanned Events			
Hazardous Materials Spills		✓	✓
Erosion and Sediment Control Failure		✓	✓
Bridge or Culvert Washout		✓	✓
Fires		✓	✓

5.6.5.1.1 Construction

There are several construction activities related to the Project that could affect the Wetlands VEC. The most substantive and likely interactions are a change in habitat quantity or quality as a result of the site preparation and roadbed preparation activities. Other potential environmental effects may occur during all construction phases (including surfacing and finishing, watercourse crossings and bridge construction, and ancillary structures and facilities construction). Potential environmental effects of these activities include a change in habitat quantity or quality and/or the possible loss of wetland function.

As previously indicated in Section 2.2, the route selection process began in 1987. During the route selection process, regulators and stakeholders identified known locations of wetlands within the proposed route corridors. Due to the presence of wetlands and moose habitat identified by landowners, a 10 km section was realigned to the west of the 1999 Alignment (Figure 2.1 C, Appendix B). Although not all of the wetlands were completely avoided, the 2003 realignment minimized disruption to these habitats to the extent possible, considering the other constraints (including design standards).



Although the route selection process avoids many of the wetlands in the landscape, 20 wetlands could not be avoided due to other constraints (e.g., watercourses, rare plants), and two wetlands were only identified in the field following selection of the preferred route. Twenty-two wetlands will be physically disturbed by Project construction activities. One wetland is located within 30 m of the Project footprint, but will not be directly affected by construction activities, and another wetland is now 50 m from the footprint, due to a reduction in the distance between the mainlane centrelines.

Site Preparation

Clearing and grubbing for the proposed TCH will remove vegetation and may change the quality of the habitat along the edge of the Project footprint. Only those wetlands with significant woody stems that may be cut while the ground is frozen would likely be affected during this stage of construction.

Roadbed Preparation

Roadbed preparation will remove wetland soils within the Project footprint. The extent of wetland habitat affected will be the Project footprint.

Blasting can have physical and chemical environmental effects on wetland habitat. Blasting can cause bank failure and/or rock slides and resultant filling of wetland habitat. Nitrogen-based explosives can affect wetland habitat quality by providing nutrients for aquatic plants and promoting algal growth.

The primary potential environmental effect of excavation is exposure of surface water to sulfide bearing bedrock, causing a pH reduction in wetlands to levels that are harmful to fish, and a potential loss of wetland function in wetlands supporting commercially or recreationally fished species. The environmental effects of pH reduction to fish and fish habitat are assessed in the Fish and Fish Habitat VEC, Section 5.4.

Watercourse Crossing Structures

The proposed TCH will require the installation of culverts and bridges. Installation of watercourse crossings can alter wetland habitat through drainage, flooding or extensive erosion. Improperly installed crossings (unplanned event) could also result in the harmful alteration, disruption or destruction of fish habitat and a potential loss of wetland function in wetlands supporting commercially or recreationally fished species. The environmental effects of blockage of fish passage to fish and fish habitat are assessed in the Fish and Fish Habitat VEC, Section 5.4.



Surfacing and Finishing

The handling of asphalt, concrete, hydrocarbon and hazardous materials during the construction phase and surfacing and finishing phase of the new proposed TCH, and storage of these materials at ancillary facilities could potentially affect wetlands. Interactions would most likely be considered the result of accidents, malfunctions and unplanned events.

The introduction of asphalt, hydrocarbons or liquid concrete products to wetlands can have harmful effects on wetland habitat (e.g., plant life) and a potential loss of wetland function in wetlands supporting commercially or recreationally fished species. The environmental effects of surfacing and finishing to fish and fish habitat are assessed in the Fish and Fish Habitat VEC, Section 5.4.

Ancillary Structures and Facilities

Construction of temporary ancillary structures and facilities, such as access roads, borrow areas and disposal sites, has the potential to have interactions with wetlands similar to those of site and road preparation activities.

5.6.5.1.2 Operation

Winter Safety

During winter, salt is used by NBDOT on road surfaces to aid in melting snow, and to provide clear road conditions. Road salt can enter into the environment (surface water, groundwater and soil) through storage and application of these salts. The highest concentrations are usually associated with winter and spring thaws. Road salt application has the potential to result in damage to wetland habitat and/or loss of wetland function if the wetland provides habitat for commercially or recreationally fished species or rare plant species. The environmental effects of winter safety to fish and fish habitat are assessed in the Fish and Fish Habitat VEC, Section 5.4. The environmental effects of winter safety to rare plant species are assessed in the Vegetation VEC, Section 5.5.

Proposed TCH Presence

During the Project-related activities associated with the proposed TCH presence, there is a potential for a change in water quantity or quality, and therefore wetland habitat quantity and quality.



5.6.5.1.3 Maintenance

Proposed TCH Maintenance

Ditching may be required to improve water flow, erosion or excessive vegetative growth. The primary issue of concern is the release of sediment into surface water bodies, including wetlands.

Vegetation and Wildlife Management

Clearing along the proposed TCH is part of NBDOT's regular maintenance to maintain sight lines and may involve both manual and mechanized cutting. Vegetation cutting will occur within the footprint of the Project that has been previously disturbed for site preparation and hydroseeded. Hydroseeding may introduce excess nutrients into wetlands.

5.6.5.1.4 Accidents, Malfunctions and Unplanned Events

Accidents, malfunctions and unplanned events that may occur in association with the Project and could have an adverse environmental effect on wetlands including:

- hazardous material spills;
- erosion and sediment control failure;
- bridge or culvert washout; and
- fire.

Hazardous material spills may degrade wetland habitat quality and result in a loss of wetland function if the wetland provides habitat for commercially or recreationally fished species. Hazardous material spills could be the result of construction activities (e.g., equipment fuelling or faulty vehicle components), operation activities (e.g., hazardous material transport truck accident, or excessive salt application), or maintenance activities (e.g., equipment fuelling).

Erosion and sediment control measures could fail and release sediment into wetlands during precipitation events.

Bridge or culvert washout may result in the loss of wetland function if the wetland provides habitat for commercially or recreationally fished species. This could result from storms greater than accounted for in the structure design.

Fire could alter wetland habitat in the Assessment Area. Fire may be caused as a result of construction activities (e.g., hot equipment), operation activities (e.g., discarded cigarettes or hot exhaust systems in contact with roadside vegetation), and maintenance activities (e.g., hot equipment).



The environmental effects of accidents, malfunctions and unplanned events to fish and fish habitat (in wetlands) are assessed in the Fish and Fish Habitat VEC, Section 5.4.

5.6.5.2 Environmental Effects Analysis and Mitigation

5.6.5.2.1 Construction

The following provides an evaluation of key potential Project-VEC interactions for the construction phase of the Project as summarized in the environmental effects assessment matrix (Table 5.6.4). During construction of the proposed TCH and associated roads and structures, several activities could result in a change in wetland quality and quantity, or loss of wetland function. These include any activities that involve vegetation clearing, soil disturbance or hydrological modifications (site preparation, road preparation, watercourse crossing, and ancillary structures and facilities construction). The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects.

Table 5.6.4 Environmental Effects Assessment Matrix for Wetlands (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WETLANDS</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in wetland quantity (A) Change in wetland quality (A) Loss of wetland function (A)	- Avoidance through route selection process - Follow EPP, EFG - Erosion control measures - Limit area of disturbance - Minimize work in and near wetlands	1-2	3	5/1	1	2
Roadbed Preparation	Change in wetland quality (A) Change in wetland quality (A) Loss of wetland function (A)	- Follow EPP, EFG and site specific EPPs - Identify areas of sulfide bearing rock - Obtain approval to blast from DFL and follow DFO's blasting guidelines - Implement drainage controls - Erosion control measures	1-2	1	2/1	R	2
Surfacing and Finishing	Change in wetland quality (A)	- Follow EPP and EFG - Designated fuelling and storage area should be at least 100 m from watercourses and wetlands	1	1	2/1	R	2



Table 5.6.4 Environmental Effects Assessment Matrix for Wetlands (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WETLANDS</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Watercourse Crossing Structures	Change in wetland quantity (A) Change in wetland quality (A) Loss of wetland function (A)	- Planning for watercourse installation using EPP, and Watercourse Alteration Technical Guidelines - Follow Watercourse and Wetland Alterations permit conditions - Follow EPP - Develop site specific EPPs - Limit area of disturbance - Installations to occur from June 1 to September 30	1-2	1	5/1	1	2
Ancillary Structures and Facilities Construction	Change in wetland quantity (A) Change in wetland quality (A) Loss of wetland function (A)	- Follow EPP, EFG - Erosion control measures - Limit area of disturbance - Designated fuelling and storage area should be at least 100 m from watercourses and wetlands	1	1	5/1	1	2
Key: Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Site Preparation

Where possible, and with considerable success within the limitations of other technical and environmental constraints, wetlands were avoided during the route selection process. The treed portions of the 22 ha of wetland habitat within the footprint will be cleared during site preparation. Eighteen of the 24 wetlands will be only partially disturbed and two will be completely avoided. Many of the wetlands are less than 1 ha in area.



Only one of the wetlands affected (WL3) was evaluated to be "significant" and none are considered to be provincially "significant". Less than 5 % of WL3 will be directly affected by the Project. Rare species affected by the project are likely to be found in the wetland in areas that will not be impacted. The Project is not expected to affect the habitat in WL3 with respect to wildlife productivity or biological diversity. Waterfowl habitat will be maintained in WL3. There will be no net loss of wetland function in WL3.

Wetland areas that will be disturbed during site construction do not provide habitat for S1 or "May Be At Risk" plant species. Few wildlife species of special conservation concern were recorded in any of the wetlands. Many of the wetlands may be used as thermal refugia by black bear and moose during hot periods in the summer; however, this type of habitat is not limited in the general area. Generally, the wetlands are not considered productive habitat for waterfowl.

Overall the wetlands appear to have low social/cultural value. None of them are part of any protected area such as a national or provincial park, national wildlife area, federal migratory bird sanctuary, ecological reserve, provincial wildlife management area, wildlife refuge, or game sanctuary.

As mentioned previously, erosion and sedimentation may occur during all Project phases. Erosion and sedimentation control measures and mitigation are summarized here, but apply to all phases where Project induced erosion or sedimentation is possible.

Erosion control systems will be in place to manage runoff from the construction areas. Erosion control measures are identified in Section 4.3, 4.5 and 4.17 of the EPP and Section 4.2 and 4.3 of the EFG and include erosion control fencing, check dams, use of mulch (possibly from shrubs and trees removed during clearing) and, if necessary, sedimentation control ponds. As these erosion control measures also slow the transport of surface runoff, they will also increase the potential for localized infiltration to groundwater.

For the proposed Project, sedimentation and siltation will be minimized during construction and operation with use of proper mitigative steps outlined in the EPP and EFG and in the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b). Instream work will be conducted between June 1 and September 30 so as not to coincide with periods of increased sensitivity such as spawning and egg incubation times, where possible. If it is necessary to conduct in-stream work after September 30, DFO will be consulted and the work would be carried out only after necessary authorization (*i.e.*, HADD, WAWA) has been obtained. In addition, there will be a 30 m buffer zone adjacent to each wetland and watercourse, where clearing will only occur in areas necessary for the RoW development.

A wetland compensation policy will be developed in consultation with NBDNR and Environment Canada's Canadian Wildlife Service (CWS), in accordance with Federal Wetland Policy and Provincial



Wetland Policy, and will be agreeable to CWS and NBDNR and will be based on the NBDNR Draft Proposed Wetland Mitigation Guidelines for the New Brunswick (December 2003).

Based on the wetland evaluations, consideration of the potential environmental effects of the activities required for site preparation of the proposed TCH, the proposed mitigation (e.g., avoidance through route selection, EPP, EFG, *Watercourse Alteration Technical Guidelines*), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

Roadbed Preparation

Loss of wetland area during roadbed preparation involves the excavation of wetland (i.e. organic) soils. It is possible, however, that excavation of wetland soils that may be within the Project footprint may not be necessary, depending on the final design and the thickness of the organic layer. Environmental effects of the loss of this area were evaluated for site preparation and are considered not significant. Blasting will be avoided where possible but in some instances it may be unavoidable. Should blasting be required during construction in or near a wetland providing fish habitat, authorization will be required from DFO for the use of explosives (Section 32 of the *Fisheries Act*). Blasting will be conducted in accordance with the EPP and EFG and *Guidelines for use of Explosives in Canadian Fisheries Waters* (Wright and Hopky 1998), and in full compliance with the requirements of DFO's authorization (Section 5.4).

Construction (including blasting) in or near wetlands providing fish habitat will be undertaken between June 1 and September 30, outside of the biologically-sensitive period to avoid the sensitive and critical fish life stages, where possible.

As noted above, erosion and sedimentation may occur during all Project phases, but during roadbed preparation is even more probable. Erosion and sedimentation control measures will remain following site preparation, and will be maintained as necessary.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities required for roadbed preparation of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.



Surfacing and Finishing

Specific mitigative measures in regard to storage of hazardous materials are identified in Section 4.19 of the EPP and Section 5.0 of the EFG. Storage of hazardous materials will not occur within 100 m of a wetland. Permanent storage areas for containers or drums will be clearly marked, have appropriate secondary containment, and be located on an impermeable floor that slopes to a safe collection area. Refuelling of equipment will not be undertaken within 30 m of a wetland. Wastewater from washing equipment will not be released into a wetland. Storage of all hazardous materials will comply with WHMIS requirements, and appropriate material safety data sheets (MSDS) will be located at the storage site.

With proper storage, and refuelling areas, and the use of the mitigative measures outlined within the EPP and EFG, storage, use and handling of hazardous materials during the construction phase should not result in any environmental effects on the aquatic environment. Spills or accidental release of hazardous materials are evaluated within the Accidents, Malfunctions and Unplanned Events phase.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities and physical works required for surfacing and along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

Watercourse Crossing Structures

A planning exercise has been completed for each watercourse crossing along the proposed TCH to evaluate the drainage area upstream of the proposed crossing, terrain in the area, precipitation, and stream bank material. The results will be used to determine the type, and size of the watercourse crossing.

Due to the size of the Little Presque Isle Stream and its flood zone (i.e., the wetland), a freespan structure will be installed. This will minimize the disturbance to wetland habitat and will help to minimize the interaction between the Project and wetland functions.

All watercourse crossing structures will be installed in compliance with the conditions set in the site specific watercourse alteration permit. Bridge design and installation will be done in consultation with DFO and the Canadian Coast Guard (Navigable Waters Protection Program). Sedimentation and siltation will be minimized during construction and operation with the use of proper mitigative steps outlined in various sections of the EPP and EFG and in the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b). During construction, an on-site monitor (environmental inspector) will ensure that



the installations are conducted according to the planning process, meet the Conditions of Approval as described in the Watercourse and Wetland Alteration Permit and do not introduce suspended sediments or contaminants to surface waters. Instream work will be conducted between June 1 and September 30 so as not to coincide with periods of increased sensitive such as spawning and egg incubation times, where possible. In addition, there will a 30 m buffer zone adjacent to each wetland and watercourse, where clearing will only occur in areas necessary for the RoW development.

Based on consideration of the wetland evaluations, potential environmental effects of the activities and physical works required for watercourse crossing structures of the proposed TCH, the proposed mitigation (e.g., EPP, EFG, site specific EPPs, *Watercourse Alteration Technical*), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

Ancillary Structures and Facilities Construction

Mitigation measures for ancillary structures and facilities will be similar to those described above for other construction activities (i.e., site preparation, roadbed preparation, and surfacing and finishing). Previously disturbed land such as woods roads and other cleared areas will be preferentially chosen for these temporary facilities. Any ancillary structures and facilities will be reviewed for their potential environmental effects on wetlands. In consideration of the Federal Policy on Wetland Conservation and the New Brunswick Wetlands Conservation Policy, wetlands will be avoided to the extent possible. Where applicable, a Watercourse and Wetland Alteration Permit will be obtained.

Based on consideration of the wetland evaluations, potential environmental effects of the activities required for ancillary structures and facilities of the proposed TCH, the proposed mitigation (e.g., EPP, EFG), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

5.6.5.2.2 Operation

The following provides an evaluation of key potential Project-VEC interactions for the operation phase of the Project as summarized in the environmental effects assessment matrix (Table 5.6.5). Operation of the proposed TCH will continue in perpetuity upon completion of the construction phase of the Project. During operation of the proposed TCH, winter maintenance and the physical presence of the Project could result in a change in wetland quality or loss of wetland function. The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects.



Table 5.6.5 Environmental Effects Assessment Matrix for Wetlands (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: WETLANDS Phase: Operation							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-cultural and Economic Context
Winter Safety	Change in wetland quality (A) Loss of wetland function (A)	- Develop long-term salt management plan - Implement EPP and EFG	1	1	1/2	R	2
Proposed TCH Presence	Change in wetland quality (A)	Proper road design and construction	1	1	1/2	R	2
Key: Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity 2 = Evidence of adverse environmental effects N/A = Not Applicable (A) = adverse (P) = positive Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible							

Winter Safety

Salt application is a winter maintenance activity that has the potential to affect wetlands near the proposed TCH by contamination from salt spray or run-off. The highest concentrations are usually associated with winter and spring thaws. Environment Canada (2001c) indicates that vegetation damage from aerial dispersion can occur up to 200 m from salt-treated multi-lane highways and 35 m from salt-treated two-lane highways. Blomqvist (2001) found that, while salt spray deposition can occur several hundred metres from a treated highway, over 90% of the spray is deposited within 40 m of the highway.

Environment Canada (2001c) recently completed an assessment of road salt under *CEPA*. Recognizing that a total ban of road salt could potentially compromise human safety, the focus of road salt risk management is on implementation measures that optimize winter road maintenance practices so as to not jeopardize road safety while minimizing the potential environmental effects (Environment Canada 2001c). Therefore Environment Canada has categorized road salt as a Track 2 substance, requiring Life-Cycle Management. Management instruments to reduce the potential environmental effects of road salts are being developed through a national multi-stakeholder group (which involves representation from NBDOT) working in conjunction with Environment Canada. Proposed control measures will likely be

presented in July of 2004. In accordance with Environment Canada's policy on road salt, all road agencies (e.g., NBDOT) must develop a Salt Management Plan. NBDOT is committed to developing best salt management practices in a continued effort to reduce the environmental effects of road salt on the environment, in accordance with the proposed federal *Code of Practice for the Environmental Management of Road Salts*. Currently Section 6.2 of the EPP and 5.6 of the EFG identifies salt application protection measures. Application rates identified in the *Highway Maintenance Management System Field Manual* (NBDOT 1992b) will be used to maximize the efficiency of salting and sanding and minimize the potential environmental effects.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities required for winter safety along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., long-term salt management plan, EPP, EFG), and the residual environmental effects significance-ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

Proposed TCH Presence

The contribution to runoff from the proposed TCH will be more episodic, compared to the more gradual release of water from forested/vegetated areas. However, due to the relatively small surface area of the highway compared to the area of the watersheds upgradient of most of the watercourse crossings, the potential for a substantive change in the quantity of surface water due to the proposed TCH construction is low. Improper highway design could contribute to a change in the distribution of water, such as a cut and fill resulting in water being redirected to another watershed. However, planned proper design will prevent this potentially adverse environmental effect.

There is a potential for runoff from the road surface to contain contaminants that may affect wetland water quality. The environmental effects of winter safety (i.e., salting and sanding) on surface water (including wetlands) is discussed in Section 5.3.5.2.2.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities and physical works associated with the presence of the proposed TCH and associated roads and facilities and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by the proposed TCH presence are considered not significant.

5.6.5.2.3 Maintenance

The following provides an evaluation of key potential Project-VEC interactions for the maintenance phase of the Project as summarized in the environmental effects assessment matrix (Table 5.6.6). During maintenance of the proposed TCH, ditching, vegetation control and watercourse crossing structure



repairs could result in a change in wetland quality or loss of wetland function. The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects.

Table 5.6.6 Environmental Effects Assessment Matrix for Wetlands (Maintenance)

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>WETLANDS</u>							
Phase: <u>Maintenance</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Maintenance	Change in wetland quality (A) Loss of wetland function (A)	- Implement EPP and EFG - Apply for Watercourse and Wetland Alteration Permits, follow requirements - Maintain buffer zone within 30 m of wetland	1	1	1/1	R	2
Vegetation and Wildlife Management	Change in wetland quality (A)	- Implement EPP and EFG - Follow Watercourse and Wetland Alteration Permits conditions for work within 30 m of wetland	1	1	1/2	R	2

Key:

Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation	Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ²	Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous	Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive
	Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months	Reversibility: R = Reversible I = Irreversible	

Proposed TCH Maintenance

Ditching may be required to improve water flow, erosion or excessive vegetative growth. The primary issue of concern is the release of sediment into surface water bodies. NBDOT has identified this issue in Section 6.1.4 of the EPP, which includes detailed protection measures to protect surface waters. A Watercourse and Wetland Alteration Permit will be obtained for any activities within 30 m of a wetland.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities associated with the maintenance of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG, site specific EPPs), and the residual environmental effects



significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

Vegetation and Wildlife Management

Vegetation control will be conducted by mechanical clearing during operation on the RoW (*e.g.*, road shoulders and interchanges). As stated in Section 6.1.6 of the EPP, there will be no herbicides used for vegetation control. For vegetation control activities within 30 m of a wetland, when required, a Watercourse and Wetland Alteration Permit will be obtained before initiation of activities.

Any increase in wetland nutrient levels from hydroseeding would be temporary as the applications are infrequent and these nutrient forms are readily absorbed by sediments or taken up by plants.

Based on consideration of the wetland evaluations, potential environmental effects of the individual activities associated with the vegetation and wildlife management along the proposed TCH and associated roads and facilities, the proposed mitigation (*e.g.*, EPP, EFG, Watercourse and Wetland Alteration Permit conditions), and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these activities are considered not significant.

5.6.5.2.4 Accidents, Malfunctions and Unplanned Events

The following provides an evaluation of key potential Project-VEC interactions for accidents, malfunctions and unplanned events as summarized in the environmental effects assessment matrix (Table 5.6.7). The issues related to wetlands are hazardous materials spills, erosion and sedimentation control failure, bridge or culvert washout and fires. These accidents are possible during all Project phases. Further discussion of each accident type follows the table.



Table 5.6.7 Environmental Effects Assessment Matrix for Wetlands (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: WETLANDS Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Materials Spills	Change in wetland quantity (A) Loss of wetland function (A)	- Implement EPP and EFG procedures, and provincial and federal regulations should be followed for storage and handling of materials - Contingency Plan - Employee training	1-2	1	2/1	R	2
Erosion and Sedimentation Control Failure	Change in wetland quantity (A) Loss of wetland function (A)	Implement EPP and EFG preventative measures	1-2	1-2	1/1	R	2
Bridge or Culvert Washout	Change in wetland quantity (A) Loss of wetland function (A)	Design of watercourse crossings to handle the 1 in 100 year peak discharge event	1-2	1	2/1	R	2
Fires	Change in wetland quantity (A) Loss of wetland function (A)	- Implement EPP and EFG procedures, and provincial and federal regulations should be followed for storage and handling of materials - Contingency Plan - Employee training	1-2	1	3/2	R	2
Key: Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Hazardous Materials Spills

Known hazardous materials that will be used during the construction and operation of the proposed TCH include fuels, lubricants, solvents and antifreeze. There is also a high probability that a large quantity of other various unidentified hazardous materials will be transported along this route. There is a possibility that these materials could be accidentally introduced into wetlands through a spill of these materials.



These materials could temporarily degrade wetland quality and have an effect on wetland function in wetlands that provide habitat for fish and wildlife. In addition, contaminants can accumulate in soils and be mobilized slowly over time.

Employee environmental awareness training will include the handling of hazardous materials. The likelihood of a hazardous material spill during construction will be minimized by following Section 4.19 of the EPP and Section 5 of the EFG. The design of the highway to RAD120 standards will reduce the likelihood of spills of hazardous materials due to accidents during operation of the highway. NBDOT has spill response contingency procedures identified in Section 8.1 of the EPP and Section 5.7 of the EFG. The transportation of dangerous goods is strictly regulated in New Brunswick and Canada, and the regulatory spill response system is highly co-ordinated and effective. In the unlikely event of a hazardous materials spill, the spilled material will be contained and NBDOT will assist with the clean up. Materials to facilitate a rapid containment and clean up of hazardous material spills will be available during construction in or near Watercourses and Wetlands. Site-specific EPPs will be developed for work near environmentally sensitive areas and these will address preparedness measures that are necessary to ensure effective emergency response in the event of spills is reflective of the level of sensitivity.

The magnitude of the environmental effect of a spill would be dependent on a number of factors that are difficult to predict. However, given the mitigation in place, the magnitude of environmental effects attributable to these infrequent and unlikely accidents, malfunctions and unplanned events are likely to be low, and worst case medium. Reversibility of environmental effects on wetland functions will depend on the functions involved, and the proportion of wetland area affected. Resident fish and wildlife would re-establish within the affected area.

Based on consideration of the wetland evaluations, potential environmental effects of an accidental release of a hazardous material into wetlands along the proposed TCH and associated roads and facilities, the proposed mitigation (*e.g.*, EPP, EFG), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these accidents are considered not significant.

Erosion and Sediment Control Failure

There is a potential during heavy precipitation events or flash floods for erosion control structures (*i.e.*, check dams) to fail. To reduce the possibility of this occurring, protection measures will be followed as described in Section 4.5 of the EPP. Specifically, erosion control structures will be monitored regularly and maintained in a functional condition until the grass on seeded slopes is sufficiently established to be an effective erosion deterrent. All check dams will be inspected before and after each rainfall and at least daily during periods of prolonged rainfall. All check dams found to be damaged will be repaired



immediately. Sediment deposits retained by structures will be removed when the level of sedimentation is within 100 mm of the top of the structure.

Based on consideration of the wetland evaluations, potential environmental effects of an accident, malfunction, or unplanned event, involving erosion and sediment control failure along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these accidents are considered not significant.

Bridge or Culvert Washout

There is a potential during high flood events for portions of the proposed TCH, or bridge or culvert installations, to be washed out, which would potentially affect Wetlands. This could temporarily degrade wetland quality due to increased sedimentation, or affect wetland function by deposition of debris material into the stream (concrete debris, bridge/culvert materials) in wetlands that provide fish habitat. Factors influencing the magnitude, duration and geographic extent of the environmental effect include amount and duration of flooding, type and size of washout, natural terrain surrounding the watercourse and location within the watershed. The extent of the environmental effects of such a road failure or washout on wetlands is predicted to be low, as most wetlands generally are in low-lying areas, such that the extent of effects will be limited.

Roads are most susceptible to washouts during the high flow period during and immediately following spring snow melt. Road design will focus on protection of the wetland environment by incorporating buffer zones, drainage and erosion control features and conservative culvert and bridge design criteria. Watercourse crossings (bridges and culverts) will be designed with a hydraulic capacity to handle at least the 1 in 100 year peak discharge event, and will follow the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b).

Based on consideration of the wetland evaluations, potential environmental effects of bridge or culvert washout along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., *Watercourse Alteration Technical Guidelines*), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these accidents are considered not significant.

Fires

The potential environmental effects of a fire in the Project area could be severe. A forest fire could alter wetland quality or result in a loss of wetland function (e.g., wildlife habitat, fish habitat). Fire within the Assessment Area of the proposed TCH could occur during any phase of the Project due to lightning or



human activities. Factors influencing the severity and duration of environmental effects include time of year, extent of fire damage and type of fire (chemical, forest). Risk of forest fire along the road route is possibly higher than in non-road areas due to the presence of human activity along the road route, which may be recreational or commercial in nature.

If the forest fire affects a large proportion of the wetlands, the magnitude of the environmental effect of such a fire could be medium. Reversibility of physical environmental effects of fire is high, but would occur over a number of years. Restoration of wetland quality or function would rely on the re-establishment of vegetation communities through succession, and repopulation of fish and wildlife species.

The potential for Project-related fires during Construction and Maintenance will be mitigated through equipment maintenance (e.g., power saw mufflers and vehicle exhaust systems) and proper vigilance working with power equipment in forested areas, as per Section 8.4 of the EPP. Also, any burning of vegetative debris will require permits from NBDNR and NBDELG as per Section 4.8.3 of the EFG. All construction activities will be done in compliance with regulations contained within the *Forest Fires Act*.

During all construction activities, NBDOT inspectors will monitor clearing and other relevant operations to ensure equipment is functional and personnel are trained in its use.

Fire fighting services for the Perth-Andover to Woodstock region are located in Perth-Andover, Centreville, Lakeville, Florenceville, Bath, Glassville, Bristol, Hartland, Plaster Rock, Debec, Maliseet and Woodstock. The locations of these fire stations are close enough to provide adequate response to fires during operation of the proposed TCH. The potential for Project-related fires during Operation will be mitigated through vegetation management (e.g., mowing and brush cutting) as per Section 6.1.6 of the EPP.

In the event of a fire occurring as a result of Construction or Maintenance activities, NBDOT personnel shall be prepared (i.e., will have access to round point shovel or fire extinguisher) to control and fight any fires in and about the work area, as per Section 7.4 and 8.4 of the EPP, and the *Forest Fires Act*. All fires will be reported to NBDNR. Forest fires not related to the Project will be managed by NBDNR.

Based on consideration of the wetland evaluations, potential environmental effects of an uncontrolled fire along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., EPP, EFG), contingency plans, and the residual environmental effects significance ratings criteria, the environmental effects on Wetlands by these accidents are considered not significant.



Summary

In summary, accidents, malfunctions and unplanned events may affect wetlands. Fires, spills of hazardous materials, and bridge or culvert washouts could result in a loss of wetland function (e.g., fish or wildlife habitat). These environmental effects are considered to be well mitigated, of low to medium magnitude, of short duration and reversible. Any potential environmental effects will be mitigated by the effective implementation of the EPP, contingency plans, and training/education of employees at the site. The proposed TCH will be designed for improved safety, and therefore should reduce the likelihood or frequency of vehicular accidents as compared to the existing two-lane highway. In that regard, the Project has a positive environmental effect.

5.6.5.3 Determination of Significance

Table 5.6.8 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and wetlands, after taking into account any proposed mitigation. The table also considers the level of confidence of the study team in their determination and the likelihood of potential environmental effects.

Table 5.6.8 Residual Environmental Effects Summary Matrix for Wetlands

Residual Environmental Effects Summary Matrix Valued Environmental Component: <u>WETLANDS</u>				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	2	3
Maintenance	NS	3	1	3
Accidents, Malfunctions and Unplanned Events	NS	3	1	2
Project Overall	NS	3	2	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

The residual environmental effects of the Project on wetlands, following mitigation, are the direct loss of approximately 22 ha of wetlands to construction. The wetland evaluations found that only one wetland may be considered "significant". The direct environmental effects of the Project on the residual unaffected parts of the "significant" wetland are small and mitigation will be in place during



Construction and Operation to mitigate potential environmental effects on wetland function, resulting in no net loss of wetland function. Wetland evaluations of the remaining wetlands also determined that there would be no net loss of wetland function on adjacent remnants. Compensation measures planned for the Project are expected to adequately compensate for the direct losses and ensures that the Project will result in no net loss of wetland.

The residual environmental effects are considered not significant for all project phases.

5.6.6 Compensation

A similar highway project in New Brunswick that required wetland compensation was carried out at Grand Lake Meadows (GLM). Compensation was required because the GLM is a "significant" wetland on local, regional, provincial, national or international scales. Compensation required by NBDNR for the loss of wetland function at the GLM wetlands includes:

- development of an approved compensation plan;
- document actual loss of habitat;
- a combination of habitat acquisition and restoration;
- if land acquisition cannot be fully attained, funding for wetland acquisition and restoration will be provided for the balance of wetland area not compensated for;
- compensation for direct loss of habitat values and life-support functions within the Project footprint;
- partnership and funding opportunities for loss of social/economic functions (e.g., development of public access, educational interpretive facilities, and research and management projects);
- 3:1 compensation ratio for acquisition, restoration and protection of wetland habitat outside the GLM;
- 10:1 compensation ratio for acquisition and dedication of wetland habitat within GLM; and
- a monitoring plan will be developed and implemented.

As none of the wetlands within 30 m of the Project footprint are within an ESA, or are "significant" wetlands on regional, provincial, national or international scales, the compensation ratio that has been agreed to by EC, TC, and NBDNR for the Project is 3:1.

5.6.7 Monitoring and Follow-up

Only one "significant" wetland was identified within the Assessment Area. Additional monitoring is recommended beyond that which is stipulated in the EPP to ensure protection measures are used and are working.



Wetlands within the Assessment Area will be monitored, within a short period after construction is completed, to visually assess wetland hydrology, introduction of invasive plant species, and use by recreational vehicles. The wetlands will be reassessed visually for the same parameters after a three year period following completion of construction. NBDOT will negotiate a wetlands compensation plan that will be implemented as compensation for the project. Those negotiations will include the required follow-up that arises from that negotiation. Any follow-up identified in that process will become a part of the follow-up program as required under *CEAA*.



5.7 Wildlife

5.7.1 Rationale for Selection as Valued Environmental Component

Wildlife was selected as a VEC because of the potential for interactions between Project activities and wildlife, and because of the relationship between wildlife and other biological and physical environments. In particular, this VEC addresses ungulates (specifically moose and white-tailed deer), migratory birds, and species of special conservation concern, as indicators of wildlife in the Assessment Area.

5.7.2 Environmental Assessment Boundaries

5.7.2.1 Spatial and Temporal

The spatial boundaries for the Project include the footprint and adjacent habitat where activities associated with construction, operation, and malfunctions and accidents of the Project could result in environmental effects on wildlife. For the purposes of this assessment, terrestrial habitat within the limits of clearing for the asphalt surfaces and structures is assumed to be permanently removed. Other areas in the Project footprint to be cleared and landscaped will generally result in a change in habitat type from forest to open habitat. The potential environmental effects of habitat loss and/or degradation are assessed within the context of the regional biogeoclimatic zone (*i.e.*, the Valley Lowlands Ecoregion) and the alternative terrestrial habitat available within the zone.

The temporal boundaries of the Project include the construction periods, and operation in perpetuity. Clearing activities will be conducted outside of the breeding season of most wildlife species (*i.e.*, no clearing from May 1 to August 31).

5.7.2.2 Administrative and Technical

Wildlife species of special conservation concern are protected federally under the *Species at Risk Act* (*SARA*). As defined in the *SARA*, "wildlife species" means a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and (a) is native to Canada; or (b) has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. The purpose of this act is to protect wildlife species at risk, and their critical habitat. The *SARA* is administered by Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada. Wildlife (animal) species potentially found within the assessment area and protected under *SARA* include Least Bittern and Yellow Rail.



Endangered wildlife species are protected provincially under the New Brunswick *Endangered Species Act*. The purpose of this act is to provide protection to endangered species and their habitats. The New Brunswick *Endangered Species Act* is administered by NBDNR. Bald Eagle (*Haliaeetus leucocephalus*) and Canada lynx (*Lynx canadensis*) are listed as regionally endangered.

Migratory birds are protected federally under the *Migratory Birds Convention Act*. The purpose of this act is to protect migratory birds and active nests. The *Migratory Birds Convention Act* is administered by Environment Canada.

Spatial habitat information used for the assessment includes the proposed TCH footprint (1,054 ha including access roads), and is defined by twenty two digital map tiles (78,894 ha) which give a larger view of the area traversed by the Project (Figure 5.8.1 in Section 5.8.2.2). This Agriculture and Forestry Assessment Area ("Assessment Area") was used for the assessment of agriculture and forestry in the Land Use, and Labour and Economy VECs. The data were obtained from the NBDNR Forest Inventory Mapping (1996/2000).

Information used in support of the assessment of wildlife, including the potential of the area for harbouring rare and endangered species, was obtained from forest inventory mapping (1996/2000), NBDNR aerial photography (1996/2000 at 1:12,500), NBDOT aerial photography (1999 at 1:6,000), Hinds (2000), Atlantic Canada Conservation Data Centre (ACCDC 2003), NBDNR (2003a), COSEWIC (2003) and other information from stakeholders and government departments with applicable expertise. Knowledge of the habitats affected by the Project is based on terrestrial surveys conducted in 2002 and 2003 and other information provided by the above sources, and the professional judgement of the study team.

The ungulate aerial survey boundaries are within 500 m of the alignment, with flight lines occurring 250 m on either side of the alignment. The extents of bird habitat surveyed depend on the species types surveyed. Owls were surveyed as much as 1 km from the alignment, where access was available using ground survey methods. Ground survey boundaries for most birds were within 100 m of the alignment, however more vocal species and those with large territories (e.g. hawks) may be detected at greater distance from the alignment.

5.7.3 Residual Environmental Effects Rating Criteria

A *significant adverse residual environmental effect* is one that affects wildlife (direct mortality, change in migratory patterns, habitat avoidance) or wildlife habitat (loss or change) in such a way as to cause a decline in abundance or change in distribution of population(s) of indicator/representative wildlife species over one or more generations within the assessment boundaries, defined as the Valley Lowlands Ecoregion, and natural recruitment may not re-establish the population(s) to its original level.



5.7.4 Existing Conditions

5.7.4.1 Migratory Birds

Migratory birds were studied following a protocol provided by Environment Canada (2003a). Owl and woodpecker surveys were conducted in April, followed by two site visits to each survey area in June.

Breeding bird surveys were completed in April and June 2003 along the RoW. The breeding bird surveys were conducted in 22 areas along the RoW, representing three habitat types including mature forest, wetland and grassland/agricultural habitats. Wherever possible, the largest and most contiguous examples of each habitat type crossed by the proposed TCH were selected for the study. A total of 24 areas were selected by Environment Canada and NBDNR as suitable study sites. The sites included 9 forest habitats, 9 wetland habitats and 4 grassland/agricultural habitats. Figures 5.7.1 A-D (Appendix F) indicate the survey area locations. After the selection process, one wetland site (B16) was eliminated since it is avoided due to an alignment change following initial site selection and a second site (B1) was not surveyed in June because it had been recently clear cut, and no longer was a suitable representative of the selected habitat type (*i.e.* mature forest). No suitable replacement sites were located in the field.

April surveys included owl surveys in the evenings, and surveys in the mornings targeting woodpeckers, although all species encountered were recorded. Owl surveys were conducted between April 21 and 27, 2003 in the Project area between one half hour after sunset (9:20 PM) and 12:40 AM. The survey method was modified from the New Brunswick Owl Survey (Takats *et al.* 2001). Playbacks including Northern Saw-whet Owl, Boreal Owl, Eastern Screech-Owl, Long-eared Owl, Barred Owl and Great Horned Owl were played in sequence, starting with 2 minutes of silent listening, and separated by two minutes of silent listening. A total of 14 survey locations at or near the alignment near (within 1 km of) selected mature forest and wetlands bird sites were visited using accessible roads. Survey locations included near B2 at the existing Route 2, Scott Road, Dean Road, Route 560 at River de Chute, Stairs Road near Reid Lake, A. Brown Road near Site B10, B. Smith Road, J. Clark Road, Back Greenfield Road near Site B12, Backland Road, Dryer Road, St. Thomas Road near Site B18, Estey Road, and Palmer Road (Figure 5.7.1 A-D in Appendix F). Survey conditions were affected by traffic noise where they were located immediately adjacent the existing TCH (Site B2). These noise influences were unavoidable. Species recorded in the vicinity of the alignment during the survey included Great Horned Owl, Barred Owl, and Northern Saw-whet Owl. The majority of the owls were recorded more than 300 m from the alignment. A total of 18 owls were recorded in the vicinity of six of the survey sites, however only 6 owls at three sites have at least a portion of their territory near the RoW. A Great Horned Owl was reported at the end of a survey in the vicinity of Site B10 (A. Brown Road). Northern Saw-whet Owls were recorded at Site B5 (Dean Road), and just south of Scott Road at the alignment. Two Barred Owls were recorded on either side of Dean Road. Additional surveys along the



Beaconsfield Road, well west of the alignment using sections of an existing New Brunswick Owl Survey route (Route #87) resulted in 7 Barred Owls and a pair of Saw-whet Owls.

For the morning surveys, all species of bird observed or heard near the RoW were recorded and evidence of breeding activity was gathered using techniques used in the Maritime Breeding Bird Atlas project (Erskine 1992). For the purposes of this study, species heard or observed within 100 m of the Project footprint were recorded. The breeding status of each species was determined from evidence of breeding observations. As suggested by the CWS guidelines, playbacks were used periodically during surveys, especially where there may have been a drop in bird activity. Playbacks were used more frequently during the late morning surveys when bird vocalizations were reduced. Playbacks for wetlands included Yellow Rail, Virginia Rail, Sora, Common Moorhen, and American Coot. Playbacks for forest habitats included Coopers Hawk and Red-shouldered Hawk, as recommended by CWS and NBDNR (D. Busby and S. Makepeace, pers. comm.). Woodpeckers and other raptor calls were used occasionally where expected species were not heard during the regular listening periods, and suitable habitat was present.

Particular attention was paid to the presence of target species identified by Environment Canada and NBDNR (Environment Canada 2003a). Each bird heard or observed during the survey was documented individually along with the habitat it was found in and any evidence of breeding activity exhibited. This provides information on the relative abundance of species present, as well as habitat preferences. Information on specific habitat types in which individuals were recorded is not available for the April surveys. For the June surveys, each site was visited twice, with at least one visit at each site conducted during the early morning hours, with the second survey generally conducted later in the morning, such that each surveyor generally conducted an early morning survey and a later morning survey at a different site. There were three survey teams in April and four teams conducting surveys in June. Each team consisted of an experienced bird surveyor and a navigator.

A list of the species expected to be found in the area was prepared. It was derived from the list of encountered species in the breeding bird atlas squares through which the proposed TCH passes (Erskine 1992). The list was reviewed and species characteristic of the three targeted habitat areas were identified. In total 80% of the expected species for the mature forest habitat were recorded during the surveys of the mature forest survey areas. In agricultural survey areas, 56% of the expected species of agricultural land were detected and 75 % of expected species in the wetland habitat were detected in the wetland survey areas. In all cases, additional species not on the list of expected species were recorded, due to the diversity of the habitats in each of the habitats targeted, such as forest of varying maturities adjacent wetland habitat. Of all expected species across these three habitat types, only 23 species (16%) were not detected during the various surveys. Most of these are the rarer species, or waterfowl or marsh birds that were not found in the wetlands along the route. Blackpoll Warbler was the warbler for which there was available habitat along the route that was not detected during the surveys.



Table 5.7.1 indicates the number of individuals and the highest breeding status for each species observed in the survey sites during the April surveys.

Table 5.7.1 Number of Species and Highest Breeding Status Observed in the April 2003 Morning Surveys.

Common	Binomial	Mature Forest		Wetland		Total
		Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	
Canada Goose	<i>Branta canadensis</i>			7	OB	7
Wood Duck	<i>Aix sponsa</i>	2	PR	2	PR	4
Green-winged Teal	<i>Anas crecca</i>			2	PR	2
American Black Duck	<i>Anas rubripes</i>			11	OB	11
Mallard	<i>Anas platyrhynchos</i>			4	OB	4
Osprey	<i>Pandion haliaetus</i>	1	OB			1
Northern Harrier	<i>Circus cyaneus</i>			1	OB	1
Northern Goshawk	<i>Accipiter gentilis</i>	1	OB			1
Broad-winged Hawk	<i>Buteo platypterus</i>	1	OB	3	OB	4
American Kestrel	<i>Falco sparverius</i>	1	OB			1
Merlin	<i>Falco columbarius</i>			1	PO	1
Ruffed Grouse	<i>Bonasa umbellus</i>	4	PO	8	PR	12
Common Snipe	<i>Gallinago gallinago</i>	1	PO	1	PO	2
Mourning Dove	<i>Zenaidura macroura</i>			1	PO	1
Belted Kingfisher	<i>Ceryle alcyon</i>			1	OB	1
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	70	PR	13	PR	83
Downy Woodpecker	<i>Picoides pubescens</i>	15	PR	12	PR	27
Hairy Woodpecker	<i>Picoides villosus</i>	12	PR	1	OB	13
Black-backed Woodpecker	<i>Picoides arcticus</i>	1	OB			1
Northern Flicker	<i>Colaptes auratus</i>	31	PR	22	PR	53
Pileated Woodpecker	<i>Dryocopus pileatus</i>	10	PO	2	OB	12
Blue Jay	<i>Cyanocitta cristata</i>	5	OB	7	PO	12
American Crow	<i>Corvus brachyrhynchos</i>	2	OB	6	PO	8
Black-capped Chickadee	<i>Poecile atricapillus</i>	4	PO	20	PR	24
Red-breasted Nuthatch	<i>Sitta canadensis</i>	5	OB	1	PR	6
White-breasted Nuthatch	<i>Sitta carolinensis</i>	4	PO	1	OB	5
Brown Creeper	<i>Certhia americana</i>	2	PO	3	PO	5
Winter Wren	<i>Troglodytes troglodytes</i>	5	PO	9	PO	14
Golden-crowned Kinglet	<i>Regulus satrapa</i>	2	PO			2
Ruby-crowned Kinglet	<i>Regulus calendula</i>	3	PO	5	PO	8
Veery	<i>Catharus fuscescens</i>	1	OB			1
Hermit Thrush	<i>Catharus guttatus</i>	7	PR	2	PO	9
American Robin	<i>Turdus migratorius</i>	19	PR	22	PR	41
Savannah Sparrow	<i>Passerculus sandwichensis</i>			1	PO	1
Song Sparrow	<i>Melospiza melodia</i>	4	PO	8	PO	12
Swamp Sparrow	<i>Melospiza georgiana</i>	1	OB	9	PO	10
White-throated Sparrow	<i>Zonotrichia albicollis</i>	8	PO	14	PO	22
Red-winged Blackbird	<i>Agelaius phoeniceus</i>			38	PO	38
Common Grackle	<i>Quiscalus quiscula</i>	4	OB	5	OB	9
Purple Finch	<i>Carpodacus purpureus</i>	5	PO	3	PO	8



Table 5.7.1 Number of Species and Highest Breeding Status Observed in the April 2003 Morning Surveys.

Common	Binomial	Mature Forest		Wetland		Total
		Total Reported	Highest Breeding Status*	Total Reported	Highest Breeding Status*	
American Goldfinch	<i>Carduelis tristis</i>	9	OB	11	PO	20
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	3	OB	7	OB	10
	Totals	243		264		507
*Breeding Status: OB =Observed only; PO = Possible breeder; PR = Probable breeder; CO = Confirmed breeder						

A total of 42 bird species (507 records) were recorded within the survey areas during the April morning surveys. Most of the expected woodpecker species that were specifically targeted during these surveys were recorded. Three-toed Woodpecker was recorded at one location, however it was noted well outside the Project footprint. In decreasing order of abundance, woodpecker species recorded include Yellow-bellied Sapsucker (83), Northern Flicker (53), Downy Woodpecker (27), Hairy Woodpecker (13), Pileated Woodpecker (12), and Black-backed Woodpecker (1).

Table 5.7.2 indicates the number of individuals and the highest breeding status for each species observed in the survey sites during the June surveys.

A total of 111 bird species (4,411 records) were recorded within the survey areas during the June bird surveys. The most numerous species recorded for agricultural land were Song Sparrow (81) and Savannah Sparrow (72). Forested habitat was most abundant in Ovenbird (129) and Red-eyed Vireo (120). Alder Flycatcher (84) and Red-winged Blackbird (83) were determined to be the most reported species in the wetland areas surveyed.

Other species not recorded in the survey sites, but recorded away from the alignment include: Baltimore Oriole, and migrating Horned Lark and Uplands Sandpiper.



Table 5.7.2 Number of Species and Highest Breeding Status Observed in the June 2003 Survey

Common	Binomial	Forested Land		Agricultural Land		Wetland		Total
		Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	
Common Loon	<i>Gavia immer</i>	1	OB			1	OB	2
Pied-billed Grebe	<i>Podilymbus podiceps</i>					2	PO	2
Double-crested Cormorant	<i>Phalacrocorax auritus</i>					1	PO	1
Great Blue Heron	<i>Ardea herodias</i>							
Canada Goose	<i>Branta canadensis</i>	4	PO	11	OB	1	PO	1
Green-winged Teal	<i>Anas crecca</i>			5	PR	28	PR	43
American Black Duck	<i>Anas rubripes</i>	2	PO	1	OB	5	PR	10
Mallard	<i>Anas platyrhynchos</i>	14	PR	21	PR	22	CO	25
Ring-necked Duck	<i>Aythya collaris</i>			2	PR	26	PR	61
Hooded Merganser	<i>Lophodytes cucullatus</i>	2	PO	1	PO	1	PO	3
Osprey	<i>Pandion haliaetus</i>	1	CO	6	CO	12	CO	15
Northern Harrier	<i>Circus cyaneus</i>					1	OB	8
Sharp-shinned Hawk	<i>Accipiter striatus</i>					1	OB	1
Northern Goshawk	<i>Accipiter gentilis</i>	1	CO			1	CO	1
Broad-winged Hawk	<i>Buteo platypterus</i>	3	PO	2	CO	2	PO	1
Red-tailed Hawk	<i>Buteo jamaicensis</i>					1	PO	7
American Kestrel	<i>Falco sparverius</i>	2	PR	3	PO	1	OB	1
Merlin	<i>Falco columbarius</i>			2	PR			6
Ruffed Grouse	<i>Bonasa umbellus</i>	8	PO					2
Virginia Rail	<i>Rallus limicola</i>					10	PO	18
Sora	<i>Porzana carolina</i>					3	PO	3
Killdeer	<i>Charadrius vociferus</i>	1	PO	2	PO	4	PR	4
Spotted Sandpiper	<i>Actitis macularia</i>							3
Common Snipe	<i>Capella gallinago</i>	2	PO			2	PO	2
American Woodcock	<i>Philohela minor</i>	1	OB			3	PR	5
Rock Dove	<i>Columba livia</i>							1
Mourning Dove	<i>Zenaidura macroura</i>	10	PR	1	OB			1
Barred Owl	<i>Strix varia</i>	2	CO	4	PO	6	PO	20
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	9	PO			1	PR	3
Belted Kingfisher	<i>Megascyle alcyon</i>	1	PO			1	OB	10
						5	CO	6





Table 5.7.2 Number of Species and Highest Breeding Status Observed in the June 2003 Survey

Common	Binomial	Forested Land		Agricultural Land		Wetland		Total
		Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	35	CO	3	PO	11	PR	49
Downy Woodpecker	<i>Picoides pubescens</i>	10	PO	4	PO	5	PO	19
Hairy Woodpecker	<i>Picoides villosus</i>	8	CO	5	PO	6	CO	19
Black-backed Woodpecker	<i>Picoides arcticus</i>	1	OB					1
Northern Flicker	<i>Colaptes auratus</i>	12	PR	7	PO	10	PO	29
Pileated Woodpecker	<i>Dryocopus pileatus</i>	7	PO	1	PO	7	PO	15
Olive-sided Flycatcher	<i>Nuttallornis borealis</i>	9	PR	3	PO	24	PO	36
Eastern Wood Pewee	<i>Contopus virens</i>	36	PO	3	PO	8	PO	47
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	12	PR	1	PO	6	PO	19
Alder Flycatcher	<i>Empidonax alhorum</i>	14	PO	40	PR	84	PR	138
Willow Flycatcher	<i>Empidonax traillii</i>					6	PO	6
Least Flycatcher	<i>Empidonax minimus</i>	38	PR	16	PR	16	PR	70
Eastern Phoebe	<i>Sayornis phoebe</i>	1	PO					1
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	14	PR	4	PO	22	PR	40
Eastern Kingbird	<i>Tyrannus tyrannus</i>	1	PO	2	PR	25	CO	28
Tree Swallow	<i>Iridoprocne bicolor</i>			1	PO	18	PR	19
Bank Swallow	<i>Riparia riparia</i>					20	PR	20
Barn Swallow	<i>Hirundo rustica</i>	2	CO	4	OB			6
Gray Jay	<i>Perisoreus canadensis</i>	3	CO					3
Blue Jay	<i>Cyanocitta cristata</i>	29	PR	13	PR	20	PO	62
American Crow	<i>Corvus brachyrhynchos</i>	12	PR	51	PR	10	PO	73
Common Raven	<i>Corvus corax</i>	2	PO	13	CO	8	CO	23
Black-capped Chickadee	<i>Poecile atricapilla</i>	32	PR	18	CO	52	CO	102
Boreal Chickadee	<i>Poecile hudsonica</i>	1	OB			1	OB	2
Red-breasted Nuthatch	<i>Sitta pusilla</i>	6	PO			3	PO	9
White-breasted Nuthatch	<i>Sitta carolinensis</i>	2	PO			1	PR	3
Brown Creeper	<i>Certhia familiaris</i>	11	PO	1	PO	3	PO	15

Table 5.7.2 Number of Species and Highest Breeding Status Observed in the June 2003 Survey

Common	Binomial	Forested Land		Agricultural Land		Wetland		Total
		Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	
Winter Wren	<i>Troglodytes troglodytes</i>	30	PR			14	PO	44
Golden-crowned Kinglet	<i>Regulus satrapa</i>	2	PO	2	PO	4	PO	8
Ruby-crowned Kinglet	<i>Regulus calendula</i>					5	PO	5
Veery	<i>Catharus fuscescens</i>	70	PR	33	PR	63	PR	166
Swainson's Thrush	<i>Catharus ustulatus</i>	22	PR	1	PO	9	PO	32
Hermit Thrush	<i>Catharus guttatus</i>	32	CO	3	PO	16	PO	51
Wood Thrush	<i>Hylocichla mustelina</i>	12	PR			5	PO	17
American Robin	<i>Turdus migratorius</i>	88	CO	40	CO	74	CO	202
Gray Catbird	<i>Dumetella carolinensis</i>	3	PO	3	PO			6
European Starling	<i>Sturnus vulgaris</i>			7	CO	1	PO	8
Cedar Waxwing	<i>Bombycilla cedrorum</i>	18	PR	42	PO	39	PO	99
Blue-headed Vireo	<i>Vireo solitarius</i>	25	PR	4	PO	25	PR	54
Warbling Vireo	<i>Vireo gilvus</i>					1	PO	1
Red-eyed Vireo	<i>Vireo olivaceus</i>	120	PR	48	PR	38	PR	206
Tennessee Warbler	<i>Vermivora peregrina</i>	3	PO	1	PO	1	PO	5
Nashville Warbler	<i>Vermivora ruficapilla</i>	28	PR	6	PO	21	PR	55
Northern Parula	<i>Parula americana</i>	48	PR	15	PO	34	PO	97
Yellow Warbler	<i>Dendroica petechia</i>			25	PR	37	PR	62
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	51	PR	36	PR	26	PO	113
Magnolia Warbler	<i>Dendroica magnolia</i>	76	PR	15	PR	40	PR	131
Cape May Warbler	<i>Dendroica tigrina</i>			1	PO	2	PO	3
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	69	PR			9	PO	78
Yellow-rumped Warbler	<i>Dendroica coronata</i>	4	PR			12	PO	16
Black-throated Green Warbler	<i>Dendroica virens</i>	84	PR	20	PR	18	PO	122
Blackburnian Warbler	<i>Dendroica fusca</i>	38	PR					
Palm Warbler	<i>Dendroica palmarum</i>	3	PR	16	PR	15	PO	69
Bay-breasted Warbler	<i>Dendroica castanea</i>	8	PR	5	PO	5	PO	3
Black-and-white Warbler	<i>Mniotilta varia</i>	42	PR	8	PR	23	PO	73





Table 5.7.2 Number of Species and Highest Breeding Status Observed in the June 2003 Survey

Table 3.1.2 Number of Species and Highest Breeding Status Observed at the State Level									
Common	Binomial	Forested Land		Agricultural Land		Wetland		Total	
		Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded	Total Reported	Highest Breeding Status* Recorded		
American Redstart	<i>Setophaga ruticilla</i>	52	PR	65	PR	34	PR	151	
Ovenbird	<i>Seiurus aurocapillus</i>	129	CO	10	PR	29	PO	168	
Northern Waterthrush	<i>Seiurus noveboracensis</i>	13	PR	5	PO	36	PO	54	
Mourning Warbler	<i>Oporornis philadelphia</i>	30	PR	26	PR	7	PO	63	
Common Yellowthroat	<i>Geothlypis trichas</i>	62	CO	48	PR	72	PR	182	
Wilson's Warbler	<i>Wilsonia pusilla</i>					2	PO	2	
Canada Warbler	<i>Wilsonia canadensis</i>	34	PR	8	PO	23	PR	65	
Scarlet Tanager	<i>Piranga olivacea</i>	23	PR			7	PR	30	
Northern Cardinal	<i>Cardinalis cardinalis</i>	1	PO					1	
Rose-breasted Grosbeak	<i>Phœucticus ludovicianus</i>	18	PR	7	PO	22	PO	47	
Indigo Bunting	<i>Passerina cyanea</i>					1	PO	1	
Chipping Sparrow	<i>Spizella passerina</i>	1	PO	8	CO	1	PO	10	
Savannah Sparrow	<i>Passerculus sandwichensis</i>	2	PR	72	PR	6	PR	80	
Song Sparrow	<i>Melospiza melodia</i>	15	PO	81	CO	32	CO	128	
Lincoln's Sparrow	<i>Melospiza lincolni</i>	7	PO			3	PO	10	
Swamp Sparrow	<i>Melospiza georgiana</i>	3	PO	1	PR	24	PR	28	
White-throated Sparrow	<i>Zonotrichia albicollis</i>	65	CO	32	PR	48	PR	145	
Dark-eyed Junco	<i>Junco hyemalis</i>	2	PO			1	PO	3	
Bobolink	<i>Dolichonyx oryzivorus</i>			24	PR	5	PR	29	
Red-winged Blackbird	<i>Agelaius phoeniceus</i>			4	PR	83	CO	87	
Rusty Blackbird	<i>Euphagus carolinus</i>					2	OB	2	
Common Grackle	<i>Quiscalus quiscula</i>	13	PR	31	PR	70	CO	114	
Brown-headed Cowbird	<i>Molothrus ater</i>			1	PO	1	PO	2	
Purple Finch	<i>Carpodacus purpureus</i>	21	PR	9	PO	17	PO	47	
American Goldfinch	<i>Carduelis tristis</i>	22	PO	43	CO	23	PO	88	
Evening Grosbeak	<i>Hesperiphona vespertina</i>	3	PO			7	PO	10	
Totals:		1754		1057		1600		4411	
*Breeding Status:									
OB	Observed only	PR	Probable breeder						
PO	Possible breeder	CO	Confirmed breeder						

*Breeding Status:

OB Observed only
PO Possible breeder

PR Probable breeder
CO Confirmed breeder



5.7.4.1.1 Bird Species of Special Conservation Concern

Table 5.7.3 lists bird species of special concern that were recorded during the various bird surveys. No species listed in Schedule 1 of the *SARA* or in the *New Brunswick Endangered Species Regulation* were recorded in the bird survey areas. There are no known Bald Eagle nests within 500 m of the Project footprint.

Table 5.7.3 Bird Species of Special Conservation Concern Recorded in the Survey Area.

Scientific Name	Common Name	ACCDC Rank *	NBDNR Status**
Red-tailed Hawk	<i>Buteo jamaicensis</i>	S4B	Sensitive (B)
Great Crested Flycatcher	<i>Myarchus crinitus</i>	S4B	Sensitive (B)
Purple Finch	<i>Carpodacus purpureus</i>	S4B	Sensitive (B)
Virginia Rail	<i>Rallus limicola</i>	S3B	Sensitive (B)
Willow Flycatcher	<i>Empidonax trailii</i>	S1S2B	Sensitive (B)
Wood Thrush	<i>Hylocichla mustelina</i>	S3B	May Be At Risk (B)
Northern Cardinal	<i>Cardinalis cardinalis</i>	S2B	Sensitive (B)
Indigo Bunting	<i>Passerina cyanea</i>	S3B	Secure (B)
*ACCDC Ranks			
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.		
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.		
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).		
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).		
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).		
S#B	Breeding: The rank refers to the breeding population of the element in the province.		
**NBDNR Status:			
At Risk:	Species for which a formal assessment has been completed, and determined to be at risk of extirpation or extinction. To be described by this category, a species must be either listed as Endangered or Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or as Endangered or Regionally Endangered under the <i>New Brunswick Endangered Species Act</i> and accompanying regulations.		
May Be At Risk:	Species or populations that may be at risk of extirpation or extinction, and are therefore candidates for a detailed risk assessment. It includes species that are of concern because of low numbers, population declines, or habitat pressures – often in combination with a lack of information concerning these factors.		
Sensitive:	Species which are not believed to be at risk of extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk. This rank does not necessarily imply that all of the factors influencing a population are of concern, or that management or recreational use of those species is likely to cause them to become at risk.		
Secure:	Species that are not believed to be At Risk, May Be At Risk, or Sensitive. These were generally species that were widespread and/or abundant. Although some Secure species may be declining, their level of decline was not felt to be a threat to their status in the province.		

The presence of six species of special concern that also appeared on the list of CWS target species, was reported within the survey sites. These included: Red-tailed Hawk, Great Crested Flycatcher, Purple



Finch, Virginia Rail, Willow Flycatcher and Wood Thrush. As noted above, the locations of bird survey areas are shown in Figures 5.7.1 A-D (Appendix F).

Red-tailed Hawks primarily nest in woodlands and often forage in open areas including cutovers (Erskine 1992). One Red-tailed Hawk was recorded in a coniferous treed swamp in the survey area (B12) and was listed as possibly breeding due to its occurrence in suitable nesting habitat. The breeding population of Red-tailed Hawk is considered "Sensitive" in the province of New Brunswick, according to NBDNR (2003a), although it is ranked S4 by ACCDC.

Great Crested Flycatchers commonly nest in woodlands (Erskine 1992). There were forty records of this species in 11 of the 22 survey sites, primarily in forested and wetlands habitats during the June 2003 survey. The survey areas where Great Crested Flycatchers were observed include B2, B8, B9, B10, B12, B13, B14, B17, B20, B23 and B24. Of the forty records, fourteen individuals were recorded as probably breeding due to the observation of pairs and agitated behaviour. Twenty-four individuals were recorded as possibly breeding due to their presence in areas of suitable nesting habitat. The remaining two individuals exhibited no indication of breeding. During a site visit to Site B2 separate from the bird surveys, a pair of Great Crested Flycatchers was observed copulating, and entering a nest cavity. The breeding population of Great Crested Flycatchers is considered "Sensitive" in the province of New Brunswick, according to NBDNR (2003a), although it is ranked S4 by ACCDC.

Purple Finch are known to build their nests in conifers, however they frequent open mixed woodland and well-treed gardens, as well as spruce/fir forests (Erskine 1992). A total of forty-seven Purple Finch were recorded in the survey area during the June surveys. They were primarily located in forested and wetland areas, however several were observed on agricultural land. The survey areas where they were observed include B2, B3, B4, B5, B6, B7, B9, B10, B12, B13, B21, B23 and B24. Twelve individuals were recorded as probable breeders since pairs and territorial behaviour were observed. Thirty-one individuals were recorded as possibly breeding due to their presence in areas of suitable nesting habitat. Four individuals exhibited no indication of breeding. The breeding population of Purple Finch is considered "Sensitive" in the province of New Brunswick, according to NBDNR (2003a), although it is ranked S4 by ACCDC.

Virginia Rail generally breed in marsh habitat (Erskine 1992). Three individuals were recorded in the survey area, all in a wetland (B19). All three were listed as possible breeders due to their presence in suitable nesting habitat. The breeding population of Virginia Rail is considered "Sensitive" in the province of New Brunswick, according to NBDNR (2003a). ACCDC (2003) ranks the breeding population of Virginia Rail in New Brunswick as S3.

Willow Flycatchers generally frequent shrubby habitats (Erskine 1992). Six Willow Flycatchers were observed in a mixedwood treed swamp in the survey area (B13). All six were listed as possible breeders



due to their presence in suitable nesting habitat. The breeding population of Willow Flycatcher is considered "Sensitive" in the province of New Brunswick, according to NBDNR (2003a). ACCDC (2003) ranks the breeding population of Willow Flycatcher in New Brunswick as S1S2. Although documented records of Willow Flycatcher are relatively few, it is believed that this species is increasing in numbers in the province (D. Busby, pers. comm.). It is almost identical in appearance to the Alder Flycatcher, and is generally distinguished by its call notes and song. Alder Flycatcher was also recorded in site B13, in the wetter portions of the habitat.

Wood Thrushes occur in hardwood forest (Erskine 1992), and are most often associated with seepage areas within these forests. They are at the northeast limit of their range in the Maritimes. A total of seventeen Wood Thrushes were observed in the survey area (B2, B6, B7, B12, B19, and B23). Twelve individuals were recorded in forested areas, and five in or adjacent wetland habitat. Seven were listed as probable breeders due to their displays of agitated and territorial behaviour. Ten individuals were listed as possible breeders due to their presence in suitable nesting habitat. The breeding population of Wood Thrush is classed as a "May Be At Risk" species in New Brunswick, according to NBDNR (2003a). ACCDC (2003) ranks the breeding population of Wood Thrush in New Brunswick as S3.

One occurrence of Northern Cardinal was recorded amid immature hardwoods bordering an agricultural area (B23). This is a species that was not listed on the target list but is a species considered by NBDNR (2003a) to be "Sensitive". ACCDC (2003) ranks the breeding population of Northern Cardinal in New Brunswick as S2. Northern Cardinals frequent shrubbery, thickets and wood edges, close to garden feeding stations (Erskine 1992).

Indigo Bunting was observed one time during the June 2003 survey (B12). The species is known to prefer forest edges, thickets and shrubbery (Erskine 1992). This species was not included on the target list and is considered "Secure" by NBDNR (2003a), but is a species with a breeding population ranked as an S3 species in New Brunswick by ACCDC (2003). It was recorded as possibly breeding, due to its presence in suitable breeding habitat. However, the habitat in close proximity to the Project footprint is not considered critical habitat for this species, and there is no lack of apparently suitable habitat in the region.

CWS Target Species

Additional bird species recorded during the June 2003 study that have no official species of concern ranking but which did appear on the CWS target list of species include: Olive-sided Flycatcher, Canada Warbler, Boreal Chickadee and Rusty Blackbird.

Olive-sided Flycatchers are characteristically found in open woodlands and other places where scattered trees remain (Erskine 1992). A total of thirty-six Olive-sided Flycatchers were recorded in the survey



area: twenty-four in wetland habitat; nine in forested habitat; and three in agricultural areas. The survey areas where they occurred included B6, B7, B8, B9, B10, B12, B13, B14, B17, B18 and B20. Three were considered probable breeders, while most (29) were considered possible breeders due to their observed presence in suitable nesting habitat. Four individuals exhibited no indication of breeding. Most were associated to some degree with nearby wetland habitats. Their relative abundance and distribution along the alignment suggests that they are likely relatively common in the landscape, as long as there are wetlands present.

Canada Warblers are usually found in dense understory vegetation of mature to mid-age mixed forests, most closely associated with broad-leafed trees and shrubs, but with conifers usually present too (Erskine 1992). In total, sixty-five individual Canada Warblers were recorded in 13 of the 22 survey areas during the June 2003 survey. The survey areas where they occurred included B2, B4, B9, B10, B12, B13, B14, B15, B17, B18, B20, B23 and B24. They were primarily observed in forested and wetland habitat areas, with several recorded adjacent agricultural areas. Of the sixty-five individuals, fifty-one were recorded as possible breeders due to their observed presence in suitable nesting habitat. Twelve individuals were considered probable breeders due to displays of agitated and territorial behaviour. Two Canada Warblers were observed within the survey sites but exhibited no indications of breeding. The distribution and numbers of Canada Warbler recorded during the surveys would suggest they are relatively abundant in the landscape. Canada Warbler was also noted as relatively abundant further south near the Saint John River during surveys in support of another highway project.

Boreal Chickadees are found in forests, particularly spruce forests (Erskine 1992). A total of two boreal chickadees were recorded in the survey area: one in wetland habitat and one in forested habitat (B6 and B18, respectively). No evidence of breeding was observed. The scarcity of this species was unexpected, however would suggest there may be relatively little suitable habitat for this species in the Project footprint.

Rusty Blackbirds frequent cool habitats in spruce bogs, swamps and alder swales (Erskine 1992). A total of two individuals were recorded in wetland habitats (B6 and B14). No evidence of breeding was observed. The habitat in the study would be considered marginal for this species, and the lack of historic record for this species in the area would tend to support this.

5.7.4.2 Ungulates

5.7.4.2.1 Historic Data and Public Consultation Summary

Moose habitat was incorporated into the original selection of the alignment, using mapping provided by NBDNR based on an aerial survey conducted March 24, 1998. The results of the survey support the public comments that the area between Dryer Road and Raymond Road between Strong Corner to the



west and Route 103 to the east had a high incidence of moose and deer. This area is low lying with mature cedar stands. As a result of public comments and geotechnical concerns, the alignment was moved out of the low-lying mature cedar forest, to as far as possible to the west, however not so far as to impede on agricultural land.

The Project is entirely within Wildlife Management Area (WMA) 10, within NBDNR Region 4. The WMA includes the area between Grand Falls and Woodstock west of the Saint John River, and on the east side of the Saint John River bordered by Grand Falls, Plaster Rock, Juniper Station, and Bristol. Most of the Crown land in this WMA is located east of the Saint John River, and is where much of the hunting pressure in this zone occurs (N. Prentice, pers. comm.).

The 2002 registered resident moose kill for WMA 10 was 65 moose, compared with 2,020 for the province, or 3.2% of the provincial registered kill (NBDNR 2003b). The 2003 quota, however was reduced from 111 in 2002 to only 10 in 2003 due to other mortality factors (NBDNR 2003b; N. Prentice, pers. comm.).

The 2002 registered resident deer kill for WMA 10 was 566 deer, compared to 6,443 for the province, or 8.8% of the provincial registered kill (NBDNR 2003b). The kill per km² for WMA 10 for 2002 was 0.20, nearly double the provincial rate of 0.11 per km². The antlerless deer hunt is currently limited in the province, in order to increase the population.

Land within the Assessment Area has the highest density of agricultural land, and has very little Crown land, compared to other areas of WMA 10. However, there are many small woodlot owners and some freehold land (H.J. Crabbe and Sons Limited) in the vicinity of the Project. Forestry activities in this area result in a changing landscape, and the creation of foraging habitat for moose and deer.

5.7.4.2.2 Winter Aerial Survey

An aerial survey was conducted on March 1, 2003, targeting moose and deer along the alignment. NBDNR Region 4 forest ranger Allen Goodine from the Perth-Andover District Office participated in the survey, conducted in a helicopter, with a pilot experienced at conducting aerial moose and deer surveys. Two JWEL biologists were the other two observers. Conditions were good, with a clear sky and no wind, and temperatures were between -10 and -1°C. Although it had been three days since there was at least a trace of snow, NBDNR recommended that the survey not wait for a significant snowfall before conducting the survey (N. Prentice, pers. comm.). Snow depths in the region were around 1.5 m, which was restricting deer movement in most areas.

The pilot used a series of coordinates on either side of the RoW, located approximately 250 m from the line. The pilot flew up the eastern side of the alignment from Woodstock to Perth-Andover, and down



the western side from Perth-Andover to Woodstock. An 8 km section from Beaconsfield Road to Dean Road west of the alignment was flown as well, resulting in a total flight path near the proposed alignment of approximately 160 km.

Results of the aerial survey are presented in Figures 5.7.1 A-D (Appendix F), distinguishing between areas with old and fresh moose tracks, and identifying areas with evidence of potential deer wintering habitat, based on the habitat type and the presence of deer and/or tracks. Old tracks were those visible, however were altered due to snow fall and/or melting snow. New tracks were those that were likely made within a few days of the survey. Moose and deer sightings are also displayed on this figure.

Other mammal species recorded during the aerial survey included porcupine, coyote, and otter. Fisher was noted during the flight more than 10 km north outside the Project boundaries.

The density of moose encountered during the survey was relatively low, at 0.05 moose per km flown, or 0.11 moose per km of new highway. Density of deer was 0.125 per km flown (0.29 per km of new highway). The present TCH south of Perth-Andover on the east side of the Saint John River is not an area of exceptionally high moose collision rates (N. Prentice, pers. comm.)

The Assessment Area is not a major deer wintering area in the region (N. Prentice, pers. comm.). Some potential deer wintering habitat was identified along the route (Scott Road, Dean Road, River de Chute, Strong Corner, Raymond Road, and the proposed Hartland Interchange), generally in areas of mature conifer-dominated forest. Most of the management of mature coniferous forest habitat occurs on Crown land, and in major tracts of freehold land, neither of which were present in the vicinity of the alignment. Due to the size of the potential deer wintering habitat areas and the number of deer recorded during the aerial survey, these areas are not likely used by a substantive number of deer. Larger tracts of mature forest (e.g., east of Strong Corner, Clarke Bog to the west of Strong Corner, Payson Lake west of Jacksontown) likely support a much larger proportion of the wintering deer in the vicinity, compared to the habitat in the survey area. The area where the most deer were recorded (Strong Corner) is located in an area with suitable wintering habitat on either side of the alignment. In most areas where there were smaller concentrations of deer, potential habitat exists on either side of the alignment.

As evidenced by the observed tracks and moose activity observed during the aerial survey, moose are generally not restricted to wintering areas in the Project area, even with the observed snow depths in the winter, and therefore their movement is not impeded. The necessary wintering habitat that can be limiting for moose is early successional habitats containing browse. As a result, moose wintering distribution shifts with the changing landscape. As mature hardwood stands are cut, moose are attracted to these areas as the browse species regenerate.



5.7.4.2.3 Other Observations

During bird surveys and both 2002 and 2003 wetland and plant surveys, incidental observations were made of wildlife. Moose sightings and sign were observed throughout the Assessment Area, in particular north of Little Presque Isle River. Moose sign were observed in nearly all of the wetlands, in mature cedar stands, and in and adjacent to clear-cut areas. Moose often made use of the NBDOT cutlines as travel corridors. The area between Dryer road and Raymond Road had a relatively high rate of encounters with moose during June bird surveys. This was the section of the proposed TCH where the route was changed, partially due to the public identifying the area to the east as having a high density of moose relative to the rest of the alignment. Although much of the land use immediately west of the alignment in this area is agricultural, there is some wetland and forest habitat remaining.

5.7.4.2.4 Consultation with NBDNR

The results of the aerial survey were provided to NBDNR for discussion purposes. NBDOT has reviewed the information and provided a preliminary plan for incorporating corridors and wildlife fencing based upon design constraints and the aerial surveys. This preliminary plan was reviewed with Norman Prentice, NBDNR Region 4 Regional Manager.

The experience from road construction north of the Project is that routing highways through areas of older uncut forests may result in cutting of adjacent habitats by the woodlot owners, due to the opportunistic access. The result is the attraction of moose to the edge of the RoW, where their presence was not previously reported. Given the changes in the landscape that are occurring and are likely to occur in the near and distant future due to forestry practices and the highway construction activities themselves, NBDNR has recommended that the details of where to locate corridors and fencing be developed over the course of project development. Corridors, however, will have to be selected relatively early in the design process.

5.7.4.3 Other Wildlife Species of Special Conservation Concern

5.7.4.3.1 Mammals

Under the New Brunswick *Endangered Species Act*, two mammals are protected as endangered and regionally endangered (respectively) in the Province:

- Eastern cougar (*Felis concolor cougar*); and
- Canada lynx (*Lynx canadensis*).



The occurrence of these species has not been confirmed in the Project area. Cougars have not been confirmed in New Brunswick until 1992 (Cumberland and Dempsey 1994) in Juniper, although the cougar was not confirmed as an eastern cougar. Biologists are now wondering if there was ever a subspecies of cougar, and now refer to eastern cougar as cougar (*Felis concolor*) (Libby 2000).

In New Brunswick, Canada lynx tend to inhabit forested wilderness areas favouring mature forests with a dense undercover of thickets and windfalls. They will inhabit other types of habitat as long as they contain minimal forest cover and adequate numbers of prey (*i.e.*, snowshoe hare). There are no records of lynx sightings within the Project area (C. Libby, pers comm.), and the likelihood of encountering lynx in this area is low given the landscape in this area (*e.g.*, agricultural land). The proximity of the alignment to human habitation and road network also decreases the likelihood of Canada lynx in the Assessment Area.

There are no known records of species listed in Schedule 1 of *SARA*, within the Assessment Area. COSEWIC lists Gaspé shrew (*Sorex gaspensis*) as the one mammal listed as a species of special concern in New Brunswick. This species has a very restricted known range in New Brunswick. One of only two recorded sites for this species is Moose Mountain, located approximately 5 km from River de Chute, on the east side of the Saint John River.

The Gaspé shrew is a small and slender insectivore with a long tail; it is light grey in colour. It is considered closely related to the long-tailed shrew (*Sorex dispar*) of the Appalachian Mountains area. The known habitat preference of the Gaspé shrew is rock outcrops and talus slopes in highlands where there are steep slopes. Although steep slopes are located between Perth-Andover and River de Chute, immediately to the west of the alignment, aerial photos (1:6,000 scale taken during November 1999) did not reveal any talus slopes, and field crews did not encounter this habitat type during the various surveys along the route. Given the specific habitat requirements of this species, it is very unlikely to be present in close proximity of the Project footprint.

Long-tailed shrew is ranked a questionable S1 (due to the uncertainty of the rank) by ACCDC (2003) and "May Be At Risk" by NBDNR (2003a). This species has only been recorded at two locations in Albert County in southern New Brunswick and Colchester County in northern Nova Scotia. The range of long-tailed shrew in nearby Maine extends only to the central part of the state. Long-tailed shrews inhabit humid, moss-covered talus slopes within softwood or sometimes deciduous forests. The ecologically similar rock vole (*Microtus chrotorrhinus*) is ranked S1 by ACCDC (2003) and sensitive by NBDNR (2003a). Rock voles inhabit a restricted ecological niche, occurring in humid, moss covered rocks formed on talus slopes at high elevations; the species is rarely found below 915 m (3000 ft) elevation, but has been located down to 451 m (1500 ft). Rock voles are frequently associated with rocky areas near streams running through coniferous forest stands. At mountain peaks, fog and dew can



provide the moisture and humidity needed by this species. Given the specific habitat requirements of this species, it is very unlikely to be present in close proximity of the Project footprint.

Bat species of special conservation concern ranked S1, S2, or S3 by ACCDC and ranked "At Risk", "May Be At Risk", or "Sensitive" by NBDNR, include eastern pipistrelle (*Pipistrellus subflavus*; ranked S2?; "Sensitive"). Other bats ranked S4 by ACCDC but "Sensitive" by NBDNR include northern long-eared bat (*Myotis septentrionalis*) and little brown bat (*Myotis lucifugus*). Eastern pipistrelle, northern long-eared bat and little brown bat are most sensitive during the winter months when regional populations have congregated into a few locations. Disturbance at these sites can potentially result in the deaths of large numbers of bats. There are no known hibernation sites such as caves or mines in the Assessment Area so these species are unlikely to be present during the period from November to May when they are hibernating. There was no karst (an irregular limestone region with sinks, underground streams, and caverns) topography found within the Project boundaries. The sink holes associated with karst topography often form over solution caves, which can provide hibernation sites for a number of bat species including eastern pipistrelle which prefer solution caves. No critical habitat for these species is known to occur in the Project area.

Given the lack of likely interaction between the Project and the mammal species discussed above, mammals species of special conservation concern are not brought forward in the environmental effects analysis.

5.7.4.3.2 Herpetiles

Wood Turtle

Background

Wood turtle (*Glyptemys insculpta*), a species of both provincial and national concern, are classed as S3 by the ACCDC, in New Brunswick, and considered "Sensitive" by NBDNR (2003a). Their range in Canada is restricted to Ontario, Quebec, New Brunswick and Nova Scotia, and is listed as a species of special concern in these four provinces by COSEWIC (2003). The general status in Canada is "Sensitive", although in Quebec, wood turtle is a "May Be At Risk" species.

Wood turtles typically occur in relatively small populations of up to a hundred or so in any given area. These populations are found along stretches of riparian habitat with cobble and gravel areas of river bottom on meandering watercourses through rich intervale habitats. A core wood turtle habitat feature of such sites is the presence of high depositional sandy banks that are scoured by winter and spring floods, reducing the establishment of shading vegetation cover. These banks must be high enough to



generally be dry by the mid June onset of nesting and the, mid June to mid September, incubation period.

Distinctly amphibious in nature, wood turtles hibernate in larger rivers and brooks, within their habitat, most frequently in areas with greater than a meter of water depth and generally out of the main current. In early spring wood turtles emerge from hibernation/brumation and stick close to their main watercourse habitats, alternately basking on the banks and seeking shelter from cooler temperatures in the water. At this time the males frequently journey up and down the main streams seeking breeding opportunities, though breeding attempts may occur throughout the active period from late April to early October (varies with local or yearly climate fluctuations), relatively far from core habitat, whenever males encounter females. As spring's often cold night temperatures grow milder, wood turtles make more frequent excursions onto land to feed and often spend days out of the water though they seldom remain far from a watercourse. They also make excursions high up on local tributaries far from their hibernaculae. In mid June, mature gravid females congregate at suitable natural sandy or gravelly riparian beaches to lay eggs, and then disperse after the eggs are laid. They may also choose other nesting sites proximal to the river or occasionally further afield that have suitable open, well drained, and friable substrates for nesting. Often these are anthropogenic in nature such as railway and roadbeds, gravel or sandpits, and farm fields near rivers. While some such sites may offer excellent nesting opportunities; others, such as tilled fields and roadbeds, may offer special hazards to eggs, hatchlings and most importantly to the breeding females. Wood turtles slow to mature, long-lived, and have only modest reproductive potential. As such, any disturbance situation that reduces hatching success, recruitment of juveniles into the adult population, or increases mortality of the adult breeding population above a normal level, can result in precipitous population declines.

Wood turtle populations are able to persist in the face of human alterations to their habitat. Indeed, much of their riparian intervale habitat is influenced by human activities, and in many sites with turtle populations, altered in part to pastures, hayfields, cropland, road and railways, in addition to forestry and other activities. Human activities harmful to wood turtle populations include:

- aggregate removal from riparian beaches or sources of sediment inflow to the river system;
- excessive erosion induced deposition into waterways;
- allowing cattle to congregate on riparian beaches inhibiting nesting or later trampling nests (this could also apply to people);
- introduction of pollutants that reduce the survival or the reproductive success of the turtles;
- indirectly creating conditions that increase egg predator (such as raccoons, red fox and striped skunk) populations, increasing the normally heavy predator induced mortality of eggs and hatchlings beyond a sustainable level;
- accidental kills of turtles on roadways or with machinery in farm fields; and
- sporadic casual removal of adults or juveniles as pets.



Directed intensive removal of adults and juveniles for the commercial pet trade can even more quickly induce a rapid decline in, or local loss of, a wood turtle population.

Results of Investigations

Areas initially identified as having the greatest potential to support, and possibly provide core habitat for wood turtles included the larger waterways. Aerial photography showing these watercourses did not suggest classic riparian nesting beaches within the proposed Project footprint, including the access road crossings. These sites included River de Chute, the Big Presque Isle Stream, Little Presque Isle Stream, and near the Lower Guisguait Brook adjacent to the Project footprint. These larger waterway crossings were visited during spring breeding bird surveys and plant surveys by a field technician experienced in assessing habitat for wood turtle. These major riparian crossing areas could, however, be described as potential wood turtle habitat well suited for foraging and as general movement corridors. No wood turtles or unequivocal evidence of such were noted during site visits to any of these larger watercourses throughout the routing. Not encountering wood turtles is not an unusual situation during spot checks of any one site, as they are a reasonably cryptic species of low population density, even about core habitat and during prime observational season. No prime nesting beaches were noted at or immediate to any of the crossing imprints. Any other potential nesting sites in these areas were absent or of an extremely marginal nature unlikely to provide significant nesting opportunities. No evidence of nesting (e.g., egg shells and egg predator dug holes) was noted. Similarly the relatively shallow depths and swift currents of all the major stream crossings with the exception of the Little Presque Isle Stream crossings, offered little suitable hibernaculae. In the instance of the Little Presque Isle Stream crossings, the relatively still waters were deep enough for hibernating but appeared to be of a mostly soft silt or organic bottom. Additionally the only potential nesting sites, at this broad marshy, slow flowing, reach of the river, were in nearby tilled fields and on soil exposures in pastures excessively trampled by cattle, and thus extremely marginal.

Almost all of the small streams and brooks crossed by the alignment could be said to provide potential summer foraging habitat for wood turtles. This would be particularly true if such small streams were relatively near and connected to larger streams and rivers having core wood turtle habitat features that indeed supported wood turtle populations. Again no wood turtles were encountered during surveys of the area but this alone in no way excludes potential wood turtle presence and seasonal use. Such streams may provide summer foraging and mating opportunities and even serve as movement corridors between populations essentially inhabiting larger streams in different watershed areas.



Dusky Salamander

Background

Northern dusky salamander (*Desmognanthus fuscus*) is classed as S3 by the ACCDC, in New Brunswick, and considered "Sensitive" by NBDNR (2003a). Their known range in Canada is restricted to Ontario, Quebec, and New Brunswick and is listed as not at risk in these three provinces by COSEWIC (2003). The general status in Canada is "Sensitive", although in Ontario and Quebec, it is a "May Be At Risk" species.

Characterized as one of the most common species of salamander in North America due to its extensive range, this species occurs from parts of Louisiana, and Alabama and Mississippi, up to southeastern Canada. In Canada the dusky salamander is known only from the more southern and western areas of New Brunswick and from South Eastern Quebec mostly east of the Saint Lawrence River and not extending up into the Gaspé. In Ontario the only known historical record was from the Niagara River Gorge, and while long thought to be extirpated, the species was relocated from this region (Kamstra 1991). In the Maritime Provinces, the prehistoric development of the Tantramar Marshes and the Northumberland Strait has evidently kept an ecologically similar stream associated species, the Northern two-lined salamander (*Eurycea bislineata*), from colonizing either Nova Scotia or Prince Edward Island. The same may be suggested for the northern dusky salamander. Apparently suitable habitat for both these stream associated salamander species is present in these other Maritime Provinces, though in the case of the Dusky salamander it is not clear if populations extend up to the Northumberland Strait shore or towards the Nova Scotia border.

In New Brunswick the extent of the range of this elusive, and perhaps overlooked, salamander is not well known. Most records are in the southern and southwestern areas of the Province. The largest populations of this species are in Browns Flats in southwestern NB and the northern range was only previously known to extend to Woodstock. Over the entirety of their extensive range south of New Brunswick, northern dusky salamanders are known from a variety of aquatic and semi-aquatic forested habitats. Seeps and small streams with plenty of mosses, rocks, logs and other cover along the edges and into the water are favoured habitat. The southern coastal plain form (*D. f. conanti*) is even said to occur along the margins of swamps and sluggish, muddy lowland streams (Petranka 1998). In northern locations in the United States that the surveyor has visited, and in locations the surveyor has discovered dusky salamanders, or examined a known location (Fundy National Park) in New Brunswick, the habitat may be described as, cool, clear water, fishless seepage and spring head streams (M. MacDonald, pers. comm.). These streams are situated in and shaded by a mature cover of trees which also shelters at least the nearby terrestrial habitat. Forest cover can vary from deciduous to mixed to coniferous species.



In most locations along the routing, forest cover was mature deciduous, dominated by sugar maple, but in one instance white cedar was dominant. At one site in Fundy National Park, spruce appeared to dominate. Old growth and mature forest cover provide significant layers of leaf litter and humus that retains moisture, more large limb and trunk debris for cover and moist hideaways and a shaded, multilayered canopy that minimizes drying of leaf litter during dry periods. These conditions benefit exclusively terrestrial species such as red-back salamanders, as well as more amphibious species like northern two-lined and dusky salamanders, by allowing them basic habitat needs and maximizing the time salamanders can spend foraging on the forest floor where food availability is greatest. The benefits to stream salamanders of mature forest cover are even more pronounced. Retention of mature forest cover keeps streams cool, mostly clear of silt and permanently flowing. Even if a stream was naturally of an ephemeral or intermittent nature, mature forest cover in the area will retain areas of extensive water flow and pools as long as possible. Clear cutting over or near such streams leads conditions hostile to stream salamander survival. These include increase in water temperature, scouring flood flows followed by seasonal drying of waterways, and dryer, hotter terrestrial environment that restricts if not precludes foraging above ground or cover. These conditions generally lead to declines in stream salamander populations, if not local extirpation. For example, without perennial stream flows, northern two-lined salamanders cannot breed successfully, as their larvae generally require 2-3 years to transform from their gilled stage.

While northern two-lined salamanders generally lay eggs beneath rocks in the stream, northern dusky salamanders generally lay their eggs terrestrially, with the female also in attendance as with two-lined salamanders, in or beneath stream side moss mats and clumps, under logs, leaf piles or other debris in mid to late summer. The young enter the streams post hatching and in some cases fall water levels may reach their nests and stimulate hatching or make entry to the water easier. Northern dusky larvae studied in Kentucky and Ohio enter the water in the fall, and grow little during the fall and winter and had a larval stage lasting 9 months (Jutterblock 1990). Wilder (1913) estimated transforming dusky salamander larvae, found in June, in Massachusetts were 8-10 months old. Obviously any seep or streamlet harbouring a breeding population of dusky salamanders must have water in it from at least fall to early summer, though a brief dry period in late summer would not necessarily preclude dusky salamanders breeding there. Northern dusky salamanders, like many stream associated species are sensitive to altered water flow patterns, and high temperatures in their streams as well as pollution and siltation. Stream siltation and high metal concentrations appear to be the two main factors in eliminating this species from many of the streams draining coal strip mines in parts of Kentucky and Tennessee (Gore 1983). Forest clearing in and around habitat leads to scouring, siltation, and loss of cover generally lowering stream salamander populations. Increased acidification of aquatic habitat can decrease or eliminate populations. While acid precipitation is a concern, especially in poorly buffered areas, acidic drainage from mines, or exposures of acid bearing rock during road construction would be deleterious to stream salamander populations, as they are to fish, despite many salamanders having somewhat more acid tolerance than many fish,



Results of Investigations

Surveys for amphibian species along the alignment, interchanges and associated access roads were conducted in 2002 and 2003 concurrently with breeding bird, plant, and wetland surveys. Transformed and adult northern dusky salamanders are readily distinguishable from the other six species of salamander known from New Brunswick. The robust hind legs compared to the more slender forelimbs of dusky salamanders alone is sufficient to differentiate them from the northern two-line salamander. The surveyor has had past experience with the species in several U.S. locations.

Northern dusky salamanders were encountered only occasionally. Locations discovered in 2002 included three seep streams from the Bairdsville area near the rich forest site hosting the rare Canada violet (12 found), and a spring head pool feeding into Wark Brook near Perth-Andover, in Victoria County (one found). An additional northern dusky salamander site was located in 2003 in a forest-situated seep spring head, immediately below a potato field, just south of the Backland Road, in Carlton County (three males, one female and one juvenile found). In all cases the particular small watercourse in question appeared to be fishless, as several streamlets were obviously intermittent in nature and would be inhospitable to fish. Also most streamlets where dusky salamanders were found were located in mature deciduous dominated forest or forest patches that had not been subject to any recent (*i.e.*, in the last 20 years or more) cutting pressure. The Wark Brook site near Perth-Andover was in a sloping stream valley in which the immediate forest cover about the brook was dominated by mature white cedar. In all the dusky salamander sites northern two-lined salamanders were also found to be present in the same general habitat. In one instance a small male northern dusky salamander was found under the same large rock less than 10 cm from an adult male northern two-lined salamander. Only adult and sub-adult dusky salamanders were noted. Dusky salamanders were characteristically located in cool, clear water seeps and streamlets, generally under rocks near the waters edge, approximately 70 cm² or greater in area, that had shallow water under them. In instances where a salamander was located in a dry section of stream it was found within the stream channel, under a rock where substrate moisture was greatest.

Additional searches were performed in early August 2003 specifically for dusky salamander in potential habitat located both along, and off the Project footprint. This was done in an effort to see if indeed northern dusky salamanders were present more generally along the route and to show their presence in the area off route as well. Four sites not encountered enroute to another survey subject were chosen from aerial photos. The known dusky salamander site south of the Backland Road was re-examined as a control. Salamanders were not discovered at any of the survey sites, however two dusky salamanders were found at the control site, near Backland Road.

In summary, northern dusky salamanders were located from five sites along or proximal to the Project footprint between Perth-Andover and Florenceville. These salamanders were present from shallow



seepage streams and springhead seeps within mature forest cover. While northern two-lined salamanders also invariably seemed to be present in the same habitat with the Dusky salamanders, this more widespread (in New Brunswick) species was generally noted in a far greater number of streams along the routing, and from less specific stream habitat types. It may be that northern dusky salamanders may be less able to cope with fish presence than northern two-lined salamanders or otherwise have more specific habitat requirements, or are less able to persist or re-colonize areas post disturbance event like clear cutting. The species may however simply be generally less abundant and more cryptic at any given site than are northern two-lined salamanders, and thus not as easily detected. With their long larval period and overlap of larval year classes in a given permanent stream, northern two-line salamanders would be more detectable than dusky salamanders for that reason alone.

The current state of Wildlife populations in the vicinity of the Proposed TCH and habitat as available within the Assessment Area (22 map tiles – 78,894 ha) provide a benchmark for the evaluation of cumulative environmental effects on wildlife, as they reflect the sum of the environmental effects that are acting upon them.

5.7.5 Environmental Effects Analysis

5.7.5.1 Project-VEC Interactions

Table 5.7.4 provides a summary of the potential environmental effects resulting from the Project-VEC interactions, including those of past, present and likely future projects. The table is divided according to each of the Project phases assessed (construction, operation and maintenance), as well as for accidents, malfunctions and unplanned events. The discussion following the table provides an analysis of key Project-VEC interactions, by Project phase.

Table 5.7.4 Project Activity – Environmental Effects Interaction Matrix for Wildlife

Potential Interactions Between Project Activities and Environmental Effects					
Valued Environmental Component: <u>WILDLIFE</u>					
Project Activities and Physical Works	Potential Environmental Effects				
	Change in Habitat Quantity	Change in Habitat Quality	Habitat Fragmentation	Direct Mortality	Loss of Species of Special Conservation Concern
Construction					
Site Preparation	✓	✓	✓	✓	✓
Roadbed Preparation		✓	✓	✓	✓
Watercourse Crossing Structures	✓	✓	✓	✓	✓



Table 5.7.4 Project Activity – Environmental Effects Interaction Matrix for Wildlife

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>WILDLIFE</u>					
Project Activities and Physical Works	Potential Environmental Effects				
	Change in Habitat Quantity	Change in Habitat Quality	Habitat Fragmentation	Direct Mortality	Loss of Species of Special Conservation Concern
Ancillary Structures and Facilities Construction	✓	✓	✓	✓	✓
Operation					
Winter Safety		✓			
Proposed TCH Presence		✓	✓	✓	✓
Maintenance					
Proposed TCH Maintenance		✓			
Vegetation and Wildlife Management		✓		✓	
Accidents, Malfunctions and Unplanned Events					
Hazardous Materials Spills		✓		✓	✓
Erosion and Sediment Control Failure		✓			
Bridge or Culvert Washout		✓			
Fires	✓	✓	✓	✓	✓
Vehicular Collisions				✓	✓
Wildlife Encounters				✓	✓

5.7.5.1.1 Construction

There are several construction activities related to the Project that could affect the Wildlife VEC, however the main environmental effect is the loss and resultant fragmentation of habitat due to site preparation activities. There is also the potential for direct mortality of wildlife or loss of species of concern unable to escape disturbances, such as some herpetiles, active migratory birds nests, and small mammals. The breeding season for birds is generally the most critical, since eggs and nestlings cannot move from sources of disturbance. Construction activities may result in the destruction or permanent abandonment of nests or increased predation of eggs and young during temporary abandonment. Birds and other wildlife in general can also be affected by habitat loss and sensory disturbance, as well as the creation of edge habitat. Construction of the proposed TCH will result in the creation of edge habitat. Edge habitat has both positive and negative implications for birds. Edge habitats often support a large number and variety of bird species. Edges also tend to attract generalist predators such as raccoons, red fox, coyote, dogs, cats, crows and jays. They may also attract Brown-headed Cowbirds a nest parasite of passerine birds (*i.e.*, perching songbirds of the order Passeriformes). The presence of high concentrations of predators and Brown-headed Cowbirds along habitat edges can result in these areas becoming reproductive sinks in which large numbers of birds attempt to breed but have poor breeding success.

Linear developments such as highways also have the potential to fragment habitats. Some species may be reluctant to cross roadways causing populations to be isolated in habitat fragments. These fragments may be too small to support a population of a particular species particularly if it requires forest interior habitats for survival. Physical isolation of a population combined with the deleterious environmental effects of edge may eliminate species in habitat fragments.

Clearing and grubbing will result in the removal of trees, shrubs and other ground cover such as herbaceous plants, brush piles and deadfalls that provide cover and foraging habitat for various birds and other wildlife. This will result in the displacement of wildlife that have historically used the habitat within the Project footprint and in adjacent habitats. Noise from construction activities including blasting can disturb wildlife in the habitat adjacent the Project footprint.

The proposed TCH will require the installation of culverts and bridges. Wildlife species susceptible to activities affecting watercourses include riparian nesting birds and stream-associated salamanders (e.g., dusky salamander).

5.7.5.1.2 Operation

Operational activities that could potentially affect wildlife include the presence of the highway, and winter maintenance activities. Traffic on the proposed TCH could disturb birds nesting or foraging in habitats adjacent to the roads. The presence of wildlife fencing is meant to keep wildlife, especially moose and deer, off the highway, and direct them to wildlife corridors. This fencing could keep ungulates from critical habitat if corridors are not suitable, and if such habitat is not available on either side of the highway. Improperly designed fencing can result in the trapping of ungulates within the RoW. Salt contamination of watercourses could affect stream-associated salamanders, and residual salt concentrations on the side of the proposed TCH could attract wildlife such as moose and deer during the spring.

5.7.5.1.3 Maintenance

The potential environmental effects of the maintenance of infrastructure such as pavement, lines, signage and guiderails would be similar to or less intrusive than the environmental effects of the original construction of these structures. These activities would likely be of smaller scale and extent than during construction, and of low frequency. Vegetation maintenance (*i.e.*, mowing) can result in the destruction of nests should birds choose to nest within the grassy medians, slopes and ditches, and if the activity occurs during the breeding season.



5.7.5.1.4 Accidents, Malfunctions and Unplanned Events

Hazardous materials spills on land would generally be localized and unlikely to interact substantially with wildlife, as these would most likely occur in disturbed or other anthropogenic areas. However, spills in watercourses could affect stream-associated salamanders, and potentially affect other wildlife use of watercourses (e.g., as a drinking water source), as contamination could be carried a considerable distance downstream and a spill in a watercourse or area frequented by migratory birds is prohibited under the *MBCA Migratory Bird Regulations*. Similarly, erosion and sediment control failure, as well as a bridge or culvert washout could affect stream-dwelling wildlife.

Fire events during any phase of the Project could affect the remaining habitat area or quality for wildlife, and result in the displacement of wildlife. Similar to clearing activities, direct mortality of eggs or nestlings, as well as wildlife such as salamanders and some small mammals could result from an uncontrolled fire.

Vehicular collisions includes collisions with wildlife. Without the use of extraordinary measures, the risk of collisions with moose or deer cannot be eliminated, however they can be reduced with the appropriate use of wildlife barriers and corridors. Moose are most active at dawn and dusk. They are very hard to see at night, (their eyes do not reflect light like those of deer) and their dark coat makes them nearly invisible after dark. Collisions with other wildlife such as birds, small mammals and herpetiles are also likely to occur on the new proposed TCH, as on other highways in the province.

Wildlife encounters are possible, especially during manual clearing activities, and locations where food debris may be present and attract animals such as raccoons and bears. The removal of problem or nuisance animals may be required for safety reasons. NBDNR would be contacted in these instances.

5.7.5.2 Environmental Effects Analysis and Mitigation

5.7.5.2.1 Construction

During construction of the proposed TCH and associated roads and structures, several activities could have environmental effects on wildlife. These include any activities (site preparation, road preparation, watercourse crossings) that involve vegetation clearing resulting in a loss of suitable breeding or foraging habitat, and resulting in fragmentation and potential direct mortality and loss of species of special conservation concern. The sections following this table describe the mitigative strategies aimed at mitigating these potential environmental effects. The discussion is grouped in the major components of the Wildlife VEC, including Migratory Birds, Ungulates, and Wildlife Species of Special Conservation Concern.



Table 5.7.5 Environmental Effects Assessment Matrix for Wildlife (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: WILDLIFE Phase: Construction							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	- Change in habitat quantity (A) - Change in habitat quality (A) - Habitat fragmentation (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Route selection - Follow EPP and EFG - Limit area of environmental effect - Use designated roadways and access; limit offroad activity - Clear outside of breeding season, and grub as early as possible. - Avoid clearing during periods when deer are yarding	1-2	3-4	3-6	1	2
Roadbed Preparation	- Change in habitat quality (A) - Habitat fragmentation (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Follow EPP (Section 4) - Use designated roadways and access; limit offroad activity	1-2	3-4	3-6	R	2
Watercourse Crossing Structures	- Change in habitat quantity (A) - Change in habitat quality (A) - Habitat fragmentation (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Follow EPP (site specific for major watercourse crossings) - Wood Turtle Relocation Plan - Limit area of environmental effect	1-2	1	3-1	1	2
Ancillary Structures and Facilities Construction	- Change in habitat quantity (A) - Change in habitat quality (A) - Habitat fragmentation (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Follow EPP - Limit area of impact - Use designated roadways and access; limit offroad activity - Clear outside of breeding season, and grub as early as possible. - Avoid clearing during periods when deer are yarding	1	2	3-6	1	2



Table 5.7.5 Environmental Effects Assessment Matrix for Wildlife (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WILDLIFE</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Key: Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = > 10,000 km ² Frequency: 1 = < 11 events year 2 = 11 - 50 events year 3 = 51 - 100 events year 4 = 101 - 200 events year 5 = > 200 events year 6 = continuous Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = > 72 months Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context 1 = Relatively pristine area or area not adversely affected by human activity 2 = Evidence of adverse environmental effects N/A = Not Applicable (A) = adverse (P) = positive							

Migratory Birds

The breeding season is generally the most critical period for migratory bird species, since eggs and nestlings cannot escape the source of disturbance. Birds in general can also be affected by habitat loss and sensory disturbance as well as the creation of edge habitat, as a result of construction of the proposed TCH. The environmental effects of clearing and grubbing are most likely to occur when these activities are conducted during the period when most migratory bird species are breeding (predominantly from May to the end of August). Clearing and grubbing at this time may result in the direct mortality of eggs and unfledged nestlings. The killing of migratory birds or the destruction of their nests, eggs, or young is an offence under the *Migratory Birds Convention Act (MBCA)*. NBDOT will conduct most clearing of the planned RoW during the fall/winter, which should avoid potential direct adverse environmental effects on nesting birds. However, there is a small known amount of clearing (approximately 5% of the total) that may take place during the May to August timeframe. Specifically, clearing of watercourse buffer zones (typically 30 m either side of the watercourse). In addition, some clearing activities such as surveying and clearing for RoW adjustments may be required during this period. RoW adjustments may be required as mitigation for other VECs (e.g., avoidance of an unforeseen important archaeological site, or a sulfide-bearing rock vein) or due to engineering and design limitations (e.g., slope stability). Due to construction timing restrictions as a result of other legislation (i.e., Fisheries Act), site preparation activities (e.g., grubbing and grading) will take place during the May to August period. This may result in the disturbance of some groundnesting birds for a

period of up to 30 days, which is the time in which grading activities must be completed (within a given work area) as specified by the Work Progression Clause (Section 3.4.1.2.5).

Where possible, draw-down and removal of beaver dams, on ponds or wetlands where waterfowl are known to be actively nesting or raising young, will be conducted outside the May to August breeding season.

Construction within the Project footprint will result in the permanent loss of habitat for various bird species, and the creation of more open habitat for edge-nesting species. Clearing and grubbing outside of the breeding season will remove habitat for nesting birds. If adjacent suitable habitat is not available, those birds will not likely nest until nearby habitat becomes available, as most birds return to the same general area from year to year. The result is likely a higher non-breeding population. In the short term, clearing of mature forest for highway construction resembles clear-cutting of forest habitat; mature forest becomes unavailable or reduced in the immediate area. The footprint area to be cleared will be as narrow as practical to reduce the amount of lost habitat.

The Carleton-Victoria Forest Products Marketing Board (CVFPMB) is a not-for-profit organization created in 1978 by a regulation under the *Natural Products Act*. The purpose and intent of the CVFPMB is to promote the development and use of the private woodlots within Carleton and Victoria counties as a dependable source of supply of primary forest products for wood using industries. The CVFPMB negotiates prices, contracts, and market access on behalf of Wood Producers who are marketing primary forest products from within the regulated area of the Board. The CVFPMB supports an Annual Allowable Cut (AAC) of 4,000 ha per year, or 2% of the forested land base (185,000 ha) in the two counties. This AAC represents the productive capacity of the forest in private hands. This excludes industrial freehold land, which is managed for sustainability, likely more than private woodlots. Although the CVFPMB has no formal management control over how much wood private woodlot owners cut in a year, the annual cut usually fluctuates +/- 5 or 10% around the AAC (*i.e.* from 3,600 to 4,400 ha are actually cut each year). Assuming all of the 735 ha of forest habitat within the Project footprint (based on 1996/1999 forest inventory mapping) contained marketable timber, clearing of the Project footprint would represent 20% of the CVFPMB AAC. As the RoW has undergone cutting for at least the past 1 ½ years, and the remaining clearing will be spread out over the next two years, the cutting will be spread over several years, and would likely represent an average of 250 ha per year, which is within the year to year variability in the AAC (T. Fox, CVFPMB pers. comm.). The permanent loss of the forest habitat within the Project footprint represents 0.4% of the forest base in Carlton and Victoria counties, or 1.8% of the forest base within the Assessment Area. Also, the total area of forest that will be lost as a direct result of clearing for the proposed TCH is relatively small compared to the total area of forest cleared in the region to support local and regional sawmills and pulpmills. The mature or overmature portion of this habitat loss within the Project footprint is approximately 206 ha, or 28% of the forest base within the Project footprint, compared to 30% in the Assessment Area.



Up to 20 of the 115 ha (19%) of wetlands located within 30 m of the Project footprint will be directly lost due to the Project, which represents 1.2% of the 1,863 ha of the delineated wetland habitat in the Assessment Area. None of the wetlands were particularly high quality waterfowl or marsh bird habitat. The wetland with the highest number of waterfowl and marsh birds recorded was Wetland 3, where the Project footprint crosses the upstream edge of the wetland. There is far more significant wetland habitat to the west of the alignment including the Williamstown Lake Wetlands, a 820 ha ESA with a great diversity of wetland habitat types that is considered one of the most important waterfowl habitats in the region. Two Ducks Unlimited sites (Carlisle Lake and Tweedie Lake Flowage) are also located well outside of the Project boundaries.

A total of 223 ha of agriculture/grassland habitat representing 21% of the total Project footprint will be directly affected within the Project footprint. The bird surveys indicate that although many birds were recorded in association or close proximity of agricultural habitat, relatively few birds were likely nesting in this habitat. As most of this land is intensively managed, most grassland species recorded were associated with uncultivated edges and the few fallow fields in the bird survey areas.

Habitat fragmentation by the Project may adversely affect local populations of birds living adjacent to the proposed alignment but will not affect regional populations in a substantive way. The Assessment Area has already been subjected to habitat fragmentation as a result of forest harvesting activity, agricultural activity, residential and linear developments including roads. Approximately 33% of the proposed Project footprint passes through disturbed early successional habitats such as clear-cuts, shrub thickets and regenerating forest. Another 30% of the Project footprint runs through areas adjacent to existing roads, and other non-forest land use. The adverse environmental effects of habitat fragmentation can be reduced by routing the RoW through heavily disturbed areas such as agricultural land or recent clear-cuts. However given the importance of agriculture in the region, agricultural land was avoided where possible. Also, because of the distribution of properties, disturbances such as forestry or agricultural operations tend to be long and narrow and are crossed by the proposed TCH along their shortest axis rather than their longest axis making it difficult to minimize the amount of new disturbance and edge created by constructing in previously disturbed areas.

The potential residual adverse environmental effects associated with construction on migratory birds are considered not significant because the population of migratory birds within the regional biogeoclimatic zone (*i.e.*, the Valley Lowlands Ecoregion) is not expected to be affected in a substantive way. Past environmental effects on migratory birds over the past twenty years are most likely associated with changes in habitat from forestry operations and the conversion of forest land to agriculture. These activities change the habitat such that nesting habitat is reduced for some species while habitat is created for other species. However, the CVFPMB and Industrial Freehold try to manage forest lands so that the forest resource is sustainable and result in a mixture of forest development stages.



Ungulates

Moose are present throughout most of the Assessment Area (between Perth-Andover and the Hartland Interchange), as evidenced by the aerial survey and incidental observations. The selection of the routing took into account the historic moose habitat identified during the 1998 flyover by NBDNR, and modifications to the alignment were made in 2003 based on public consultations that recommended a shift in the alignment towards Strong Corner. Most of the area to the west of Strong Corner has Environmentally Significant Areas that cover much of the area and were therefore avoided. Only movement of the corridor through the agricultural land would potentially reduce the potential environmental effects on moose habitat, however, it is very likely that this could result in a substantive loss of agricultural productivity in the region. Consultations with stakeholder have suggested that such a loss would simply be offset by the clearing of adjacent forest land and conversion to agriculture (D. Prosser, pers. comm.). Clearing activities within the Project footprint and in some cases in adjacent land by private landowners during the earlier planning stages up to the first few years of construction is creating wintering habitat (browse) for moose. Roadbed preparation will affect some wetland habitat (open water for cooling and foraging of aquatic plants in summer), however alternate habitat is available in the region, and few of the wetlands within 30 m of the Project footprint are of suitable size or have open water depths to be considered critical habitat for moose. As moose are poor thermal regulators, they are attracted to large, cleared, wind-swept areas such as highways to gain relief from summer temperatures and insect attack.

The loss of a few small areas of potential deer wintering habitat located within the Project footprint is not expected to substantively affect the regional deer population. Other potential environmental effects of site preparation and the permanent conversion of the forest habitat within the Project footprint on adjacent potential deer wintering habitat include a change in habitat quality of the immediately adjacent habitat, and habitat fragmentation. The proposed Project footprint is in close proximity to several other areas of potential deer wintering habitat. Potential deer wintering habitat is however available on either side of the proposed alignment. Despite the harvesting of past deer wintering habitat and the potential environmental effects of the existing highway, larger tracts of potential deer wintering habitat remain in the region.

Although clearing in the winter is beneficial for breeding birds, clearing should not occur during periods of heavy snow conditions, when deer movement is hindered, or when deer may be yarded up in areas of deer wintering habitat within or near the Project footprint. Clearing in these areas should be conducted early in winter when snow depths are still thin.

Construction activities will be spaced out along the alignment such that they will generally not impede the movement of moose or deer across the alignment, although ungulates may avoid areas of high



construction activity. The installation of wildlife fencing will likely occur near the end of the construction schedule.

The selection of areas for inclusion of wildlife corridors and/or fencing is being determined in consultation with NBDNR. Areas proposed by NBDOT as locations for wildlife corridors, based on the winter survey and the feasibility based on topography and design constraints are typically associated with planned structures for watercourses, as well as access road crossings or other overpasses. These areas include, Big Presque Isle Stream (bridge structures), Strong Corner (overpass planned for property access road), Guisiguit Brook (watercourse crossing), River de Chute (watercourse and road crossing) and possibly Brown Brook (Figures 5.7.1 A-D, Appendix F). Wildlife fencing is proposed to correspond to the above corridor sites.

NBDNR has requested a flyover with NBDOT to have a first hand look at habitat and topography of four selected locations where deer and/or moose were recorded near the alignment, in order to relate topography to the location and expected design of the proposed TCH (*i.e.* areas of cut and fills). The flyover is planned for fall 2003. The feasibility and need for wildlife corridors in these areas will be evaluated at that time. NBDNR has also recommended a follow-up aerial survey during the next winter, to fine tune and confirm the high use areas that may warrant wildlife fencing, among other mitigation.

Based on consideration of the potential environmental effects of the individual activities and physical works required for construction along the proposed TCH and associated roads and facilities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects on ungulates from these activities are considered not significant.

Wildlife Species of Special Conservation Concern

The one Red-tailed Hawk recorded in a coniferous treed swamp in the survey area B12 was hunting near a wetland (coniferous treed swamp) at the time of the survey. It was observed flying towards suitable nesting habitat nearby in an adjacent mature hardwood hill, at a considerable distance from the Project footprint. The construction of the proposed TCH is not likely to result in the loss of the nesting area of this individual.

Great Crested Flycatchers are relatively abundant in many of the forested and near wetland habitats along the route. The relatively high abundance suggests that this species is relatively common in the region, where suitable habitat exists. The critical habitat feature of Great Crested Flycatcher is the need for natural or woodpecker-excavated cavities for nesting, preferably in hardwood and cedar trees. The presence of this species is likely closely associated with the relatively high numbers and wide distribution of woodpeckers along the proposed alignment. They were even found in the relatively fragmented habitat of site B24 at the southernmost end of the alignment. Most of the birds were, in fact,



recorded outside of the Project footprint, although many were likely nesting in habitat in close proximity to (within 100 m of) the footprint.

Purple Finch was also relatively abundant along the alignment, located in a variety of habitats along the route, including selectively cut forest and immature forest stands. Purple Finches were mostly found north of Florenceville, although they were also recorded in the fragmented landscape around site B24. Although still common in New Brunswick, Breeding Bird Survey trends indicate there has been a decrease in the population of Purple Finches over the past 40 years. The reason for this decline is not known. No critical habitat for this species has been identified within the survey sites, and there is no evidence that there is no suitable habitat outside of the alignment and within the greater Assessment Area.

Virginia Rail was reported during both site visits to site B19 (Wetland 19) in June, with one reported during the first visit, and 2 during the second. Overall, the wetlands along the route had relatively little habitat that would be considered suitable for nesting of marsh birds such as Virginia Rail. The secretive marsh bird appeared during the first site visit after playing tapes several times. As the footprint will affect a relatively small proportion of the wetland, and there are portions of the wetland that are more than 500 m from the Project footprint, this species may breed in this marsh following construction. Regardless, there is much more habitat suitable for marsh birds such as the Virginia Rail several km to the west of the proposed TCH (*i.e.*, Williamstown Lake Wetlands).

Willow Flycatchers are apparently increasing in numbers in the province (Dan Busby, pers. comm.) and its preferred habitat is not particularly limited in the landscape. They are typically more aggressive than the more common Alder Flycatcher, and may displace Alder Flycatchers from the drier sections of wetland habitats (F. Lavender, pers. comm.). It is likely that, although the habitat near Site B13 in which the Willow Flycatchers were recorded will be lost to construction, suitable nesting habitat should be available in the landscape.

Wood Thrush were recorded in a number of survey sites along the route. A close look at where they were recorded reveals that many were observed outside of the Project footprint. Site B2 was surveyed prior to the realignment in this area, so birds recorded upslope from the footprint are now at a considerable distance from the area of disturbance. Many of the records of this species during the June survey were relatively close to open habitats such as wetlands and agricultural land. Also, Wood Thrush have been known to nest close to human habitation. Therefore, Wood Thrush should still be able to persist in habitats adjacent the highway, following construction of the proposed TCH. In addition, a portion of site B2 which contains the largest recorded population of Wood Thrush encountered during bird surveys will be purchased for conservation purposes and no longer at risk of future forest harvesting.



Bird species of concern with few individuals reported included an individual Northern Cardinal recorded in immature hardwoods bordering an agricultural area, and one Indigo Bunting recorded in suitable nesting habitat (forest edges, thickets and shrubbery) adjacent an agricultural field. The habitats in which these species were reported was suitable, but there was no evidence of breeding. Even if these individuals are unable to nest in adjacent habitat, the loss of these possible breeders would not likely be significant.

No grassland/agriculture-associated bird species of special conservation concern or listed as target species by CWS were reported along the alignment, although two were recorded migrating through the area (Upland Sandpiper and Horned Lark).

Despite the presence of some bird species that have shown some historic evidence of population declines, these species are still relatively abundant in the region. The loss of some habitat for these species is not considered significant when put into the context of the regional population. Beyond the avoidance of clearing from May 1 to August 31, no other mitigation is recommended with respect to migratory birds of concern.

Wood turtles have been recorded in many of the watersheds crossed by the proposed TCH, however no critical habitat has been identified. Most of the larger watercourses will be spanned by bridges, which, following construction, should permit the passage of wood turtles as long as there is some terrestrial habitat along the stream edge, under the bridge. The many small stream crossings had no, or extremely marginal at best, potential as to nesting or hibernaculæ sites within the Project footprint, and so would not be expected to provide any core habitat for wood turtles. The only likely interaction between construction activities and wood turtle is the discovery of individuals. Wood turtles encountered in the field during construction that are at risk of harm should be relocated beyond the construction boundaries, in their direction of travel.

Dusky salamanders discovered within the Project footprint are likely to be killed during construction activities including site preparation and roadbed preparation. Dusky salamanders were found in shallow seepage streams and springhead seeps within mature forest cover. Based on the searches for this species inside and outside the Project footprint, a viable population of this species will be left undisturbed in three of the five sites following construction activities. The discovery of this species in Victoria County has resulted in a range extension for this species, and has been reported to the New Brunswick Museum. As no voucher specimens have been collected for the Museum, voucher specimens could be removed from areas where Dusky Salamanders have been reported that will be lost during construction.

Like all stream salamanders any large scale removal of forest cover from about their stream habitat and adjacent terrestrial foraging areas is detrimental. Loss of forest generally diminishes or eliminates the moist microhabitats needed by forest dwelling salamanders. Additionally for stream species, the resulting alterations to water flow regime, with potential for both increased scouring events and siltation,



as well as drying of the watercourse is detrimental. With regards to highway construction, direct loss of stream habitat and seep genesis sites to construction can have adverse environmental effects on local populations, but these impacts need not be significant in many cases if basic mitigation is applied. As long as stream flows and intact mature forest cover around them remain on either side following highway construction, then thriving populations of stream salamanders can be maintained. Care must be taken to minimize any construction derived or post construction siltation. It must also be ensured that no sulfide-bearing rock is exposed proximal to the stream or used as roadbed fill.

Possible mitigation of potential adverse environmental effects to stream salamander habitat downstream from the construction activities can include erosion control measures to prevent siltation to the mostly fishless, small streams and seeps, and avoidance of exposure of sulfide-bearing rock during construction. Leachate from such rock leads to declines in stream pH and can increase metal concentrations to toxic levels.

Based on consideration of the potential environmental effects of the individual activities and physical works required for construction along the proposed TCH and associated roads and facilities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects on wildlife species of special conservation concern by these activities are considered not significant.

5.7.5.2.2 Operation

The following section provides an evaluation of key potential Project-VEC interactions for operations as summarized in the environmental effects assessment matrix (Table 5.7.6). Operations with a potential environmental effect on wildlife include highway operation (presence of highway; vehicular traffic), and winter maintenance (salt application), which could cause a change in habitat quality, maintain habitat fragmentation, or cause direct mortality or loss of species of special conservation concern.

Table 5.7.6 Environmental Effects Assessment Matrix for Wildlife (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WILDLIFE</u> Phase: <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in habitat quality (A)	- Implement EPP and EFG - Develop long term salt management plan	1	3	5/3	R	2



Table 5.7.6 Environmental Effects Assessment Matrix for Wildlife (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WILDLIFE</u> Phase: <u>Operation</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Proposed TCH Presence	• Change in habitat quality (A) • Habitat fragmentation (A) • Direct mortality (A) • Loss of species of special conservation concern (A)	• Monitoring of moose/deer activity	1	3-4	5-6	R 2

Key

Magnitude 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation	Geographic Extent 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ²	Frequency 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous	Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive
	Duration 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months	Reversibility R = Reversible I = Irreversible	

Migratory Birds

During the operational phase of the Project, traffic on the proposed TCH could disturb birds nesting or foraging in habitats near the new road. Several studies have shown that disturbance associated with automobile traffic can have an adverse environmental effect on bird abundance and breeding success. A study of terrestrial bird abundance, species composition and breeding success in forested habitats adjacent to a busy highway in New Brunswick (JWEL 1998) revealed a reduction in bird abundance of 18% to 25% in plots located 100 and 200 m away from the road relative to control plots 500 m from the road. Evidence of breeding activity was reduced by 34% to 39% relative to control plots. These reductions were not statistically significant. A similar study conducted in the Netherlands revealed a reduction in the number of singing males from 3.3/ha in control plots to 2.1/ha in areas within 200 m of a highway (Reijnen and Foppen 1994). These data indicate that disturbance associated with operation of the road will have a measurable adverse environmental effect on local populations but is not expected to result in a significant environmental effect on regional populations. Reijnen and Foppen (1994) noted that the degree of disturbance to birds by highway traffic was best correlated with noise levels. As such, the best means of mitigating the adverse environmental effects of traffic on birds is to reduce noise levels. There is no practical or effective way in which to do this over a stretch of highway this long. Noise barriers would be prohibitively expensive and a reduction in speed limits within practical limits



would have only a minor effect on noise levels. By way of example, reduction of the speed limit from 80 kph to 70 kph would only reduce noise levels by an average of 2 dBA at a distance of 100 m from the highway.

Based on consideration of the potential environmental effects of the operation of the proposed TCH and associated roads and facilities and the residual environmental effects significance ratings criteria, the environmental effects on migratory birds by these activities are considered not significant.

Ungulates

The presence of the proposed TCH along with the vehicular traffic will fragment forested habitats remaining on either side of the highway. Deer and moose may choose not to cross the proposed TCH, or those that do, run the risk of direct mortality due to vehicle collisions. In areas where wildlife fencing is present, deer and moose will be less likely to cross. Artificial corridors are planned, and their preliminary locations, based in part on the aerial survey results, are under review and in the early stages of planning. The ever changing landscape with regards to moose wintering habitat makes it difficult to choose locations for Wildlife structures and wildlife fencing, as has been demonstrated in a previous highway project north of Grand Falls (Section 5.7.4.2.4). The east/west movement of deer and moose in the area may be affected by the proposed alignment, due to the lack of cover, and the risk from vehicle collisions.

Approximately 47 ha of potential deer wintering habitat, based on deer or track aggregations noted during the aerial survey, are located within 300 m of the RoW.

There are, however, potential deer wintering habitat, and moose habitats available on either side of the proposed TCH. The location of wildlife fencing and corridors will be fine-tuned over the next year during the design phase of the Project, in consultation with NBDNR.

The mechanism of degradation of habitats for wildlife during operation is noise. Vehicle noise could lead to displacement of wildlife and/or habitat avoidance. Deer are particularly susceptible when using deer wintering habitat, and increased energy expenditures because of disturbances could lead to lower survival. Ungulates are expected to become habituated to the noise produced by vehicular traffic, given the high frequency of traffic along the TCH.

Based on consideration of the potential environmental effects of the operation of the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., wildlife corridors and fencing) and the residual environmental effects significance ratings criteria, the environmental effects on ungulates by these activities are considered not significant.



Wildlife Species of Special Conservation Concern

Potential environmental effects on bird species of special conservation concern are the same as those for migratory birds, discussed above.

As the known population of dusky salamander in the vicinity of the Project and outside the Project footprint is located upslope of the alignment, the potential environmental effects of salt contamination of watercourses are low, however there could be as yet undiscovered populations in downgradient locations. As discussed in Section 5.4.5.2.2, NBDOT is committed to developing best salt management practices in a continued effort to reduce the environmental effects of road salt on the environment. Currently Section 6.2.1 of the EPP identifies salt application protection measures. Application rates identified in the *Highway Maintenance Management System Field Manual* (NBDOT 1992b) will be used to maximize the efficiency of salting and sanding and minimize the potential environmental effects. This should reduce the potential environmental effects of road salt on stream-associated salamanders.

Following construction activities, the presence of the proposed TCH could have an adverse environmental effect on wood turtle. More roads in wood turtle habitat mean more general habitat fragmentation, more potential for accidental roadway mortality of turtles, and more access to humans who might remove wood turtles from their habitat. In a highway project such as this the only possible mitigation, other than avoiding or minimizing any damage to any identified core habitat features (such as prime nesting sites or hibernaculae), is to utilize bridges to span the larger watercourses. For smaller stream crossings, where bridges are not necessary or feasible, implementation of the largest possible culvert design is advisable. With regards to wood turtles, such a culvert design would allow as much light as possible to enter the tunnel (anecdotal observations suggest wood turtles appear to leave the water to travel terrestrially down or up a stream, when confronted by a long dark culvert.). Additionally, at least at low water levels, the culvert would have some sort of terrestrial movement corridor. Given the lack of core wood turtle habitat, the added cost of over-sizing culverts specifically for wood turtle is not warranted in this instance.

Based on consideration of the potential environmental effects of the operation of the proposed TCH and associated roads and facilities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects on wildlife species of special conservation concern by these activities are considered not significant.

5.7.5.2.3 Maintenance

The following provides an evaluation of key potential Project-VEC interactions for maintenance activities as summarized in the environmental effects assessment matrix (Table 5.7.7). Maintenance activities with a potential environmental effect on the wildlife include proposed TCH maintenance and vegetation and wildlife maintenance (mowing and maintenance of wildlife fencing and crossings),



which could cause a change in habitat quality, maintain habitat fragmentation, or cause direct mortality or loss of species of special conservation concern.

Table 5.7.7 Environmental Effects Assessment Matrix for Wildlife (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>WILDLIFE</u> Phase: <u>Maintenance</u>								
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context	
Proposed TCH Maintenance	Change in habitat quality (A)	Follow EPP Sections 6.1 and 6.3	1	2	2/1	R	2	
Vegetation and Wildlife Management	- Change in habitat quality (A) - Direct mortality (A)	- Proper design and maintenance of wildlife corridors and fencing - Management of clear-cut areas in and near RoW to reduce browse	1	3	2/1	R	2	

Key:

Magnitude:
1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation
2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability
3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation

Geographic Extent:
1 = < 1 km²
2 = 1-10 km²
3 = 11-100 km²
4 = 101 - 1,000 km²
5 = 1,001 - 10,000 km²
6 = > 10,000 km²

Duration:
1 = < 1 month
2 = 1 - 12 months
3 = 13 - 36 months
4 = 37 - 72 months
5 = > 72 months

Frequency:
1 = < 11 events/year
2 = 11 - 50 events/year
3 = 51 - 100 events/year
4 = 101 - 200 events/year
5 = > 200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological Socio-cultural and Economic Context:
1 = Relatively pristine area or area not adversely affected by human activity
2 = Evidence of adverse environmental effects

N/A = Not Applicable
(A) = adverse
(P) = positive

Migratory Birds

Maintenance activities could disturb birds located adjacent to the proposed TCH. Maintenance activities, which will occur in conjunction with the operation of the proposed TCH, are unlikely to cause any unique disturbance to birds, beyond those environmental effects related to operational traffic. Maintenance activities such as resurfacing the TCH are not expected to have significant environmental effects on local bird populations. Disturbance associated with repairs to the road surface are not expected to be any more intense than that encountered during the construction or operational phases of the Project, and would generally be of smaller scale, and would therefore have less an effect than construction activities. In fact, habitat avoidance due to noise would be the main potential effect, which would be of limited duration and frequency. Sections 6.1 and 6.3 of the EPP provide various environmental protection measures that will help reduce potential environmental effects on wildlife, including migratory birds. Where possible, bridge maintenance activities, such as cleaning or resurfacing, will be conducted outside the breeding season (May to August) where migratory birds are known to nest on bridge structures.



Mowing and brush cutting of the vegetated slopes and drainage ditches could destroy the nests of ground nesting birds such as the Savannah Sparrow, Bobolink or Ring-necked Pheasant if birds choose to nest immediately adjacent the busy highway. None of these species are of special conservation status. In fact, no bird species of special conservation concern requiring grassland habitat was recorded during the migratory bird surveys. Currently, the maintenance branch of NBDOT mows the grassy edges and medians of the provinces highways as required, usually once per year, for safety, and partially for aesthetic reasons (*i.e.*, tourism).

Based on consideration of the potential environmental effects of the maintenance of the proposed TCH and associated roads and facilities and the residual environmental effects significance ratings criteria, the environmental effects on migratory birds by these activities are considered not significant.

Ungulates

Proposed TCH Maintenance is not expected to have an adverse environmental effect on ungulates, as it would simply be similar to highway construction activities, but on a smaller scale. Vegetation control on the edges of the proposed TCH is not expected to have an adverse environmental effect. If the vegetation control removes suitable browse species, then control of this material will serve to reduce the potential interaction with traffic.

Maintenance of wildlife structures will be required to ensure their effectiveness. This work will be of short duration and will be conducted during summer months, and therefore should have limited effects on ungulates. Further, such maintenance will ensure the continual effectiveness of the fencing, and will on balance be beneficial to local populations.

Based on consideration of the potential environmental effects of the maintenance of the proposed TCH and associated roads and facilities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects on ungulates by these activities are considered not significant.

Wildlife Species of Special Conservation Concern

Issues associated with highway and vegetation maintenance with regards to bird species of concern are the same as described above for migratory birds and incorporate the same mitigation. No such species that require grassland/agricultural land as critical habitat were reported in the surveyed areas.

Based on consideration of the potential environmental effects of the maintenance of the proposed TCH and associated roads and facilities, the proposed mitigation, and the residual environmental effects significance ratings criteria, the environmental effects on wildlife species of special conservation concern by these activities are considered not significant.



5.7.5.2.4 Accidents, Malfunctions and Unplanned Events

The following provides an evaluation of key potential Project-VEC interactions between accidents, malfunctions and unplanned events, and the Wildlife VEC, as summarized in the environmental effects assessment matrix (Table 5.7.8). The main issues related to Wildlife are fires and vehicular collisions, although hazardous materials spills, erosion and sediment control failure and bridge/culvert washout could have adverse environmental effects on stream-associated species of special conservation concern. These accidents are possible during all Project phases. Further discussion of each accident type follows the table.

Table 5.7.8 Environmental Effects Assessment Matrix for Wildlife (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: WILDLIFE Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Materials Spills	- Change in habitat quality (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Implement EPP and EFG procedures, and provincial and federal regulations should be followed for storage and handling of materials - Contingency Plan - Employee training	1	1	1/1	R	2
Erosion and Sediment Control Failure	Change in habitat quality (A)	- Implement EPP and EFG preventative measures - Contingency Plan	1-2	1 or 2	1/1	R	2
Bridge or Culvert Washout	Change in habitat quality (A)	Design of watercourse crossings to handle the 1 in 100 year peak discharge event	1-2	1 or 2	1/1	R	2
Fires	- Change in habitat quantity (A) - Change in habitat quality (A) - Habitat fragmentation (A) - Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Implement EPP and EFG preventative measures (Section 7.4) - Contingency Plan - Follow NBDNR Forest Fire Act - Design of highway to include emergency access or median roads	1-3	1 or 2	1/1	R	2
Vehicular Collisions	- Direct mortality (A) - Potential loss of species of special conservation concern (A)	- Wildlife fencing and corridors - Moose habitat signage - Monitoring of moose activity	1	3	5/2-5	R	2



Table 5.7.8 Environmental Effects Assessment Matrix for Wildlife (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>WILDLIFE</u>							
Phase: <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Wildlife Encounters	• Direct mortality (A) • Potential loss of species of special conservation concern (A)	• Keep work areas free from food debris. • Avoid off road travel. • Wood Turtle Encounter Relocation Plan • Notify local NBDNR	1	2	2	R	2

Key:

Magnitude: 1 = Low: e.g., specific group, habitat, or ecosystem localized one generation or less, within natural variation 2 = Medium: e.g., portion of a population or habitat, or ecosystem 1 or 2 generations, rapid and unpredictable change, temporarily outside range of natural variability 3 = High: e.g., affecting a whole stock, population, habitat or ecosystem, outside the range of natural variation	Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ²	Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous	Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive
	Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months	Reversibility: R = Reversible I = Irreversible	

Hazardous Materials Spills

Known hazardous materials that will be used during the construction and operation of the proposed TCH include fuels, lubricants, solvents and antifreeze. There is also a possibility that a large quantity of other various unidentified hazardous materials will be transported along this route. There is a possibility that these materials could be accidentally introduced into watercourses through a spill of these materials. These materials could temporarily degrade water quality and have subsequent environmental effects on freshwater biota including stream-associated herpetiles. In addition, contaminants can accumulate in sediments and be mobilized slowly over time. The effects of a hazardous material spills on terrestrial wildlife would generally be limited to the spill area, and would not have a significant effect in wildlife in the region. Prompt cleanup of these spills will reduce further interactions.

The magnitude of the environmental effect of a spill would be dependent on a number of factors that are difficult to predict. However, given the mitigation in place, the magnitude of environmental effects attributable to these infrequent and unlikely accidents, malfunctions and unplanned events are likely to be low, and worst case medium. Reversibility of physical environmental effects is high, due to the dynamic nature of lotic (actively flowing) water systems. The high spring flows and high bedload



transport will effectively flush the system during the spring following the event. Employee environmental awareness training will include the handling of hazardous materials. Section 4.19 of the EPP addresses hazardous materials issues. NBDOT has spill response contingency procedures identified in Section 8.1 of the EPP and Section 5.7 of the EFG. In the unlikely event of a hazardous material spill, the spilled material will be controlled and contained, and NBDOT will assist with the clean up. Materials to facilitate a rapid containment and clean up of hazardous material spills will be available on-site during construction in or near Watercourses and Wetlands. The transportation of dangerous goods is strictly regulated in New Brunswick and Canada, and the regulatory spill response system is highly co-ordinated and effective.

Based on consideration of the potential environmental effects of an accident, malfunction, or unplanned event, involving the release of a hazardous material into aquatic or terrestrial habitat along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects of hazardous material spills are considered unlikely. Given the habitat preferences and distribution of stream-associated herpetiles in the Assessment Area, the environmental effects on wildlife would not likely result in the decline of a wildlife community that would not recover in one generation and are therefore considered not significant.

Erosion and Sediment Control Failure

There is a potential during heavy precipitation events or flash floods for erosion control structures (*i.e.*, check dams) to fail, and affect any potential habitat of wood turtle or dusky salamander. However, no critical wood turtle habitat is located in the vicinity of the Project footprint, or for a considerable distance downstream based on a desktop analysis and field visits, and dusky salamander habitat not affected by the Project footprint will typically be found in more upstream sections of watercourse crossings. Nonetheless, to reduce the possibility of this occurring, protection measures will be followed as described in Section 4.5 of the EPP. Specifically, erosion control structures will be monitored regularly and maintained in a functional condition until the grass on seeded slopes is sufficiently established to be an effective erosion deterrent. All check dams will be inspected before and after each rainfall and at least daily during periods of prolonged rainfall. All check dams found to be damaged will be repaired immediately. Sediment deposits retained by structures will be removed when the level of sedimentation is within 100 mm of the top of the structure.

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event, involving erosion and sediment control failure along the proposed TCH and associated roads and facilities, and the proposed mitigation the environmental effects on Wildlife habitat would not likely result in the decline of a Wildlife community that would not recover in one generation and are therefore considered not significant.



Bridge or Culvert Washout

A bridge or culvert washout would have a similar but more severe interaction with stream-associated herpetiles such as wood turtle and dusky salamander, as described above. There is a potential during high flood events for portions of the proposed TCH, or bridge or culvert installations to be washed out. This could temporarily degrade water quality due to increased sedimentation, or affect habitat quantity by the loss of suitable nesting habitat or hibernaculae. Factors influencing the magnitude, duration and geographic extent of the environmental effect include amount and duration of flooding, type and size of washout, natural terrain surrounding watercourse and location within the watershed. The extent of the environmental effects of such a road failure or washout on herpetiles is predicted to be low due to the small area of a watershed which is covered by the watercourse crossings, and the paucity of critical habitat downstream of the water crossings. Reversibility potential is high due to the dynamic nature of stream high spring discharges and high spring bedload transportation.

Roads are most susceptible to washouts during the high flow period during and immediately following spring snow melt. Road design will focus on protection of the aquatic environment by incorporating buffer zones, drainage and erosion control features and very conservative culvert and bridge design criteria. Watercourse crossings (bridges and culverts) will be designed with a hydraulic capacity to handle at least the 1 in 100 year peak discharge event, and will follow the *Watercourse Alteration Technical Guidelines* (NBDELG 2002b).

Based on consideration of the potential environmental effects an accident, malfunction, or unplanned event involving a bridge or culvert washout along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects on wildlife would not likely result in the decline of a wildlife community that would not recover in one generation and are therefore considered not significant.

Vehicle Collisions

Direct mortality of wildlife could result from collisions with vehicles. During the operational phase of the Project, there will be bird mortality associated with collisions with automobiles. Based on general studies of avian collisions with vehicles on roads in Europe and North America (Erickson *et al.* 2001), estimates of avian mortality rates range from as low as 0.001 birds/km/yr to as high as 201 birds/km/yr. Avian mortality rates due to vehicle collision would be expected to vary with a number of factors, including, but not, limited to, volume of traffic (Noss undated), traffic speed, habitat through which the road traverses, extent of RoW clearing, bird species present and bird abundance. Roadkill data collected for a 100 Series Highway (four-lane), secondary highway and city streets in Nova Scotia over a two year period yielded an average rate of roadkill of 0.9 birds/km/yr for the 100 Series Highway, 1.2 birds/km/yr for the secondary highway and 0.7 birds/km/yr for city streets (M. Crowell unpublished data). The



proposed TCH will be a 70 km long highway, therefore, the estimated number of birds killed in collisions with automobiles would be 63 per year. This is probably an underestimate of the actual number of birds likely to be killed since small birds are easily missed during the surveys and their bodies are quickly destroyed by traffic or removed by scavengers. If it is assumed that only one in ten birds killed by traffic is recorded, the estimated number of birds killed per year would be approximately 630 birds. This number represents only a small proportion of the regional bird population.

Vehicular traffic in the general area is not expected to increase substantively, however there will be a shift in a high proportion of the traffic from the existing Route 2, which is located mostly along the Saint John River, to a more inland location. Annual average daily traffic is expected to increase by 3.73%. This increase is expected regardless of whether or not the new TCH is built. Some researchers suggest that bird fatalities are correlated with traffic volumes, however, a lack of detailed studies makes this difficult to assess. A recent review of bird fatalities on European roads presents conflicting results from separate studies (Erritzoe *et al.* 2003). A Danish study showed a greater number of birds killed on a higher traffic volume road, with 96 birds/km/yr on a main road with 2,823 vehicles/24 hr compared to 43 birds/km/yr on a secondary road with 332 vehicles/24 hr (Bruun-Schmidt 1994, cited in Erritzoe *et al.* 2003). A German study found fewer birds killed on a higher traffic volume road, with 154 birds/km/yr on a main road with 2,650 vehicles/24 hr compared to a 320 birds/km/yr on a secondary road with 780 vehicles/24 hr (Fuellhaas *et al.* 1989 cited in Erritzoe *et al.* 2003). Based on these studies, it is apparent that the relationship between bird fatalities and traffic volume is complicated and is not likely linear. Many researchers suggest that there is a learning effect, by which birds may be better able to learn to avoid traffic on roads with higher traffic volumes (Erritzoe *et al.* 2003). In the Danish study, an 853% increase in traffic volume resulted in a doubling of bird fatalities. It is likely that a 3.73% increase in traffic volume would result in an immeasurably small increase in bird fatalities. This increase in bird fatalities would be expected even if the proposed TCH is not built.

Fencing with escape mechanisms and underpasses are the most effective countermeasure to reduce deer and moose mortalities from vehicle collisions (Smiley 2002). These will be designed with input from wildlife biologists (*i.e.*, NBDNR). The most critical time for moose is during the winter, and is dependent on the availability of browse. At these times moose and deer are more likely to concentrate in smaller areas than at other times of the year. Although moose collisions will occur year round, moose are more likely to be encountered between May and October, with June, July and August being the most critical months on New Brunswick highways. As most moose collisions are expected to be reported to NBDNR, the department has an opportunity to consider these mortality rates when setting quotas for hunters in a WMA.

Where wood turtle may occur near watercourses or forested habitats along the proposed TCH, and adequate crossing structures are not available, wood turtles may be susceptible to mortalities due to vehicle collisions. As described in Section 5.7.5.2.2, suitable corridors are the only possible mitigation



for a highway. However, given that no critical wood turtle habitat is found near the proposed TCH, the likelihood for encounters is low. Also, bridge structures planned for the major watercourses are likely to provide suitable travel corridors for wood turtle.

Based on consideration of the potential environmental effects of an accident, malfunction, or unplanned event, involving a bridge or culvert washout along the proposed TCH and associated roads and facilities, the proposed mitigation (e.g., well planned placement and well design corridors and fencing), and contingency plans, the environmental effects on wildlife would not likely result in the decline of a wildlife community that would not recover in one generation and are therefore considered not significant.

Fires

Fire within the Assessment Area of the proposed TCH could occur during any phase of the Project due to lightning or human activities. Fires can never be completely eliminated from the landscape, however regulations and appropriate mitigation can reduce their probability and extent. Factors influencing the severity and duration of environmental effects include time of year, extent of fire damage and type of fire (chemical, forest). Risk of forest fire along the road route is possibly higher than in non road areas due to the presence of human activity along the road route, which may be recreational or commercial in nature.

Forest birds have diverse habitat requirements and will react differently according to the species, and the severity of the fire. Forest fires in mature forest could reduce the amount of potential deer wintering habitat, and would result in only a temporary reduction of browse in regenerating forest; vegetation regeneration after a fire would provide excellent browse for deer and moose. Shelter is not an absolute requirement for the winter survival of moose in areas of moderate winter severity.

The potential for Project-related fires during Construction and Maintenance will be mitigated through equipment maintenance (e.g., power saw mufflers and vehicle exhaust systems) and proper vigilance working with power equipment in forested areas, as per Section 8.4 of the EPP. Also, any burning of vegetative debris will require permits from NBDNR and NBDELG as per Section 4.8.3 of the EFG. All Construction activities will be done in compliance with regulations contained within the *Forest Fires Act*.

During all construction activities, NBDOT inspectors will monitor clearing and other relevant operations to ensure equipment is functional and personnel are trained in its use.

In the event of a fire occurring as a result of Construction and Maintenance activities, NBDOT personnel shall be prepared (i.e., will have access to round point shovel or fire extinguisher) to control



and fight any fires in and about the work area, as per Section 7.4 and 8.4 of the EPP, and the *Forest Fires Act*. All fires will be reported to NBDNR. Forest fires not related to the Project will be managed by NBDNR.

Firefighting services for the Perth-Andover to Woodstock region are located in Perth-Andover, Centreville, Lakeville, Florenceville, Bath, Glassville, Bristol, Hartland, Plaster Rock, Debec, Maliseet and Woodstock. The locations of these fire stations are close enough to provide adequate response to fires during operation of the proposed TCH. Mitigation measures are prevention oriented through vegetation management (regular mowing and brushing) as per Section 6.1.6 of the EPP to reduce the risk of fires from vehicles parked on the vegetation along the proposed TCH.

Based on consideration of the potential environmental effects of an accident, malfunction, or unplanned event involving a forest fire affecting wildlife habitat along the proposed TCH and associated roads and facilities, the proposed mitigation, and contingency plans, the environmental effects on Wildlife would not likely result in the decline of a wildlife community that would not recover in one generation and are therefore considered not significant.

5.7.5.3 Determination of Significance

Table 5.7.9 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and wildlife and wildlife habitat, after taking into account any proposed mitigation. The table also considered the level of confidence of the study team in this determination and the likelihood of potential environmental effects.

Table 5.7.9 Residual Environmental Effects Summary Matrix for Wildlife

Residual Environmental Effects Summary Matrix Valued Environmental Component: Wildlife				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	1	3
Operation	NS	3	1	3
Maintenance	NS	3	1	3
Accidents, Malfunctions and Unplanned Events	NS	3	1	3
Project Overall	NS	3	1	3



Table 5.7.9 Residual Environmental Effects Summary Matrix for Wildlife

Residual Environmental Effects Summary Matrix			
Valued Environmental Component:		Wildlife	
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood
			Probability of Occurrence
Key		Probability of Occurrence: based on professional judgement	
Residual Environmental Effect Rating:		1 = Low Probability of Occurrence	
S = Significant Adverse Environmental Effect		2 = Medium Probability of Occurrence	
NS = Not-significant Adverse Environmental Effect		3 = High Probability of Occurrence	
P = Positive Environmental Effect		Scientific Certainty: based on scientific information and statistical analysis or professional judgement	
Level of Confidence		1 = Low Level of Confidence	
1 = Low Level of Confidence		2 = Medium Level of Confidence	
2 = Medium Level of Confidence		3 = High Level of Confidence	
3 = High Level of Confidence		N/A = Not Applicable	
		*As determined in consideration of established residual environmental effects rating criteria.	

The residual environmental effects of the Project on Wildlife, taking into account mitigation, are the loss of an estimated 735 ha of forest and 74 ha of undeveloped land (including 22 ha of wetland), the fragmentation of habitat, and some residual mortality to wildlife (including migratory birds and moose) due to vehicle collisions and (for moose) increased hunter access. No migratory birds of special conservation concern were directly associated with the estimated 223 ha of agricultural land/grassland that will be lost to the Project. Key mitigation for migratory birds include limiting the area of critical habitat of species of special conservation concern required for the Project to the extent possible, and conducting most clearing outside the breeding season of migratory birds. Mature forest in the most important critical habitat encountered along the alignment, in terms of the type and number of migratory birds of special conservation concern recorded, including CWS "target" species. The loss of a small percentage of the available mature forest in the region from the Project is not likely to have a significant effect on migratory bird populations requiring this habitat. Forests are typically managed in such a way as to maintain a mixture of forest development stages. The purchase and future protection of an AHF stand which also contains the largest recorded population of Wood Thrush (the only "May Be At Risk" bird species) encountered during bird surveys should in part compensate for some losses of mature forest from the Project.

With respect to moose, mitigation includes route selection and refinement of the highway, and the use of wildlife fencing and crossings. The highway was realigned in the vicinity of Dryer road to Raymond Road in response to public concern that this was an area of high use by moose. NBDOT is also working closely with NBDNR biologists to select appropriate locations for fencing and wildlife crossings based on the results of aerial surveys, and to design the crossings to increase the likelihood that they will be used successfully, taking into account recent guidelines developed by NBDNR.

The residual environmental effects of the Project on Wildlife are therefore considered not significant for all phases and for the Project overall.



Based on consideration of the Project related and cumulative environmental effects, it is concluded that the wildlife and wildlife habitat resources in the vicinity of the Project have the capacity to meet the needs of the present and those of the future.

5.7.6 Monitoring and Follow-up

Monitoring of moose and deer in the vicinity of the proposed TCH is recommended in the short term to help fine tune the design of mitigation strategies (wildlife corridors and fencing). To aid in the design of wildlife corridors and fencing NBDNR and NBDOT will fly the alignment (Fall 2003) to understand the relationship between the topography and the proposed TCH to determine the need for structures and fencing. A follow-up aerial survey involving NBDNR personnel is recommended over the next winter to fine tune and confirm the high use areas that may warrant wildlife fencing, among other mitigation. NBDOT will continue to evaluate available technologies to keep moose off of highways and to provide information to motorists that will decrease the likelihood of collisions.

Other related follow-up is a recommendation for NBDOT to work with the CVFPMB to encourage the management of regenerating forest habitat near the Project footprint, so it is less attractive to moose and deer as browse. Existing management programs and money are already available to private woodlot owners, and managed by the CVFPMB. In addition, land that has already been cut, but will be within the RoW purchased by NBDOT should be managed using standard silvicultural techniques.





5.8 Land Use

5.8.1 Rationale for Selection as Valued Environmental Component

Project-interactions with current land use in the immediate vicinity of the Project will occur, and Land Use was therefore selected as a VEC. Project-related interactions with Land Use may include those residential and commercial land uses, recreational land use/access, forest resource use and agricultural uses. Environmental effects resulting from the Project on this VEC are defined by interruptions or disruptions to current land use by Project activities such that present land use activities are restricted and/or degraded and/or cannot continue at present levels.

In this section, the environmental effects of the Project activities on Land Use resulting from construction and operation, as well as accidents, malfunctions, and unplanned events are assessed.

5.8.2 Environmental Assessment Boundaries

5.8.2.1 Spatial and Temporal

The spatial boundaries for the assessment of commercial, residential and recreational land uses include the proposed TCH, and nearby (*i.e.*, <200 m) residential and recreational areas adjacent to its alignment, where activities associated with construction, operation, and accidents, malfunctions and unplanned events of the Project could potentially intersect with land use.

The spatial boundaries for the assessment of agriculture and forestry related land uses are defined by the upper Saint John River Valley, including Carleton and Victoria counties, and parts of Madawaska and York counties.

The temporal boundaries of the Land Use VEC include the four year construction period of the Project, as described in Section 3.0, and operations and maintenance in perpetuity.

5.8.2.2 Administrative and Technical

The proposed TCH is located within the counties of Carleton and Victoria. Planning within incorporated municipalities is regulated by municipal zoning regulations. Perth-Andover and Woodstock are the only municipalities through which the proposed TCH partially crosses. Most of the proposed TCH passes through rural unincorporated areas, which are regulated under the *Rural Planning District Regulation – Community Planning Act*, administered by NBDELG.



Information used in support of assessing residential, commercial and recreational land use issues was obtained from public and stakeholder consultations, mapping and property identification data, and a windshield reconnaissance survey along the existing TCH. Knowledge of the area affected by the Project is based on this information base, as well as the professional judgement of the study team.

Agriculture and forestry land-use data are based on forest cover information from NBDNR (1996 and 2000 aerial photography), NB Department of Agriculture, Department of Fisheries and Aquaculture (DAFA) and Statistics Canada information. Forestry activities at both the property and regional levels span rotations in excess of fifty years. Agricultural activities are based on shorter crop rotation schedules, three to five years covers most productions.

The spatial information used for the detailed assessment of Project-related environmental effects on both agriculture and forestry includes the Project footprint (1,054 ha including access roads), in the context of twenty-two digital map sheets (78,894 ha) that provides a larger contextual view of the area traversed by the Project. Figure 5.8.1 describes the location of the agriculture and forestry Assessment Area ("Assessment Area"). Assumptions used reflect current sectoral soil and water conservation Best Management Practices (BMPs).

Analyses of the market value of residential, commercial and other resource land uses would require very extensive and exhaustive study and research of each property. This is beyond the administrative boundary limitations of the environmental assessment as the environmental effects of the Project can be assessed, given planned mitigation, without that level of detail. Even with the support of extensive market analyses the results may not be conclusive in aggregate or at the individual property level due to externalities, lack of control, and scientific basis. Further, any analyses would be subject to criticism by property owners due to the unpredictability and fluctuations of the marketplace, subjectivity of property owners, individual business plans and decisions and financial capabilities of the individuals involved. NBDOT has and continues to negotiate fair market value settlements with property owners and land acquisitions of all properties affected by the Project.

It should be noted that changes to future land management practices as a result of better information on wood supply and the voluntary implementation of agriculture soil and water conservation BMPs, are difficult to quantify and are unlikely to represent projects or activities that will be carried out in the future that may overlap with the Project. As such, they are not considered in this assessment.

It is the professional judgement of the study team that the data available to characterize the existing land use conditions and the existing knowledge regarding the Project-VEC interactions are sufficient to support the environmental assessment.



5.8.3 Residual Environmental Effects Rating Criteria

A *significant residual environmental effect* on land use (excluding agriculture and forestry) is one where the proposed use of land for the Project and related facilities is not compatible with adjacent land use activities and plans, and the proposed use of the land will create a change or disruption that restricts or degrades present land uses such that the activities cannot continue to be undertaken at current levels for extended periods of time and cannot be compensated. Public and Stakeholder feedback comments made during open houses and various channels of communication with NBDOT and/or its agents form the basis for determining incompatible land uses.

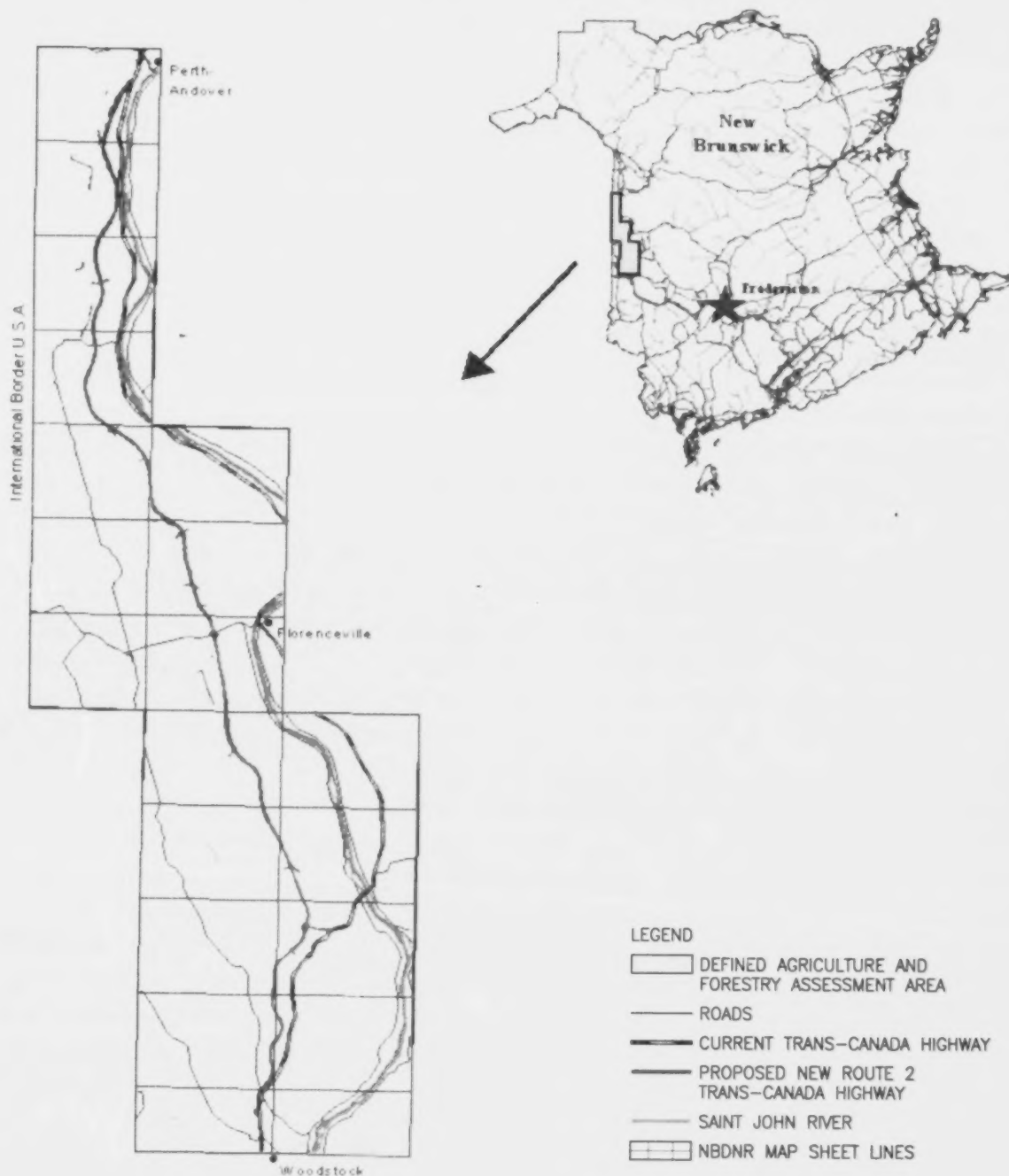
Both agriculture and forestry dominate the landscape and the local economy and consequently the local and regional scales are used. A *significant residual environmental effect* on land use for forestry and agricultural land use is one that affects the regional sector's ability and viability such that processing facilities would close or curtail operation with a substantial loss of employment, or modify commodity prices and or the producer's ability to access market.

5.8.4 Existing Conditions

The proposed Project is located within Carleton and Victoria Counties, and will pass through and/or serve a number of incorporated municipalities (Woodstock, Hartland, Florenceville, Centreville, Bath, Bristol and Perth-Andover) and 6 local service districts. Two of these local service districts, Lakeville and Simonds have advisory committees. The Project is subject to the land use plans and regulations of the incorporated municipalities it passes through, Perth-Andover and Woodstock. Currently, there are no rural land use development plans applicable to the local service districts along the proposed alignment. Land use planning for the rural areas is a responsibility of the New Brunswick Department of Environment and Local Government, as provided for by the *Rural Planning District Regulations of the Community Planning Act*.







**AGRICULTURE AND FORESTRY ASSESSMENT
AREA LOCATOR MAP
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2003 10 06

Job No.:
14677

Scale:
N.T.S.

Fig. No.:
5.8.1



Jacques Whitford
Consulting Engineers
Environmental Scientists

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The proposed Project is a by-pass route and will primarily be located on woodland and to a lesser extent on farmland. The selection of the proposed alignment by NBDOT was made to avoid existing residential, commercial and agricultural land uses as much as was reasonably possible (Section 2.0). However, the proposed alignment will pass through and run adjacent to some existing residential and commercial development, generally at locations where the proposed TCH will cross the existing TCH and other secondary roads. The proposed RoW is comprised of approximately 70% forested land, 21% agricultural land, over 7% other undeveloped land, and less than 2% developed residential, commercial or industrial property. The Project will also cross some areas used for recreational purposes including hunting and trail riding (e.g., ATV and snowmobile).

The existing TCH generally follows the Saint John River and serves as both a major interprovincial highway and a local/regional road. Most of the adjacent lands along the existing TCH are developed and used for agriculture, with commercial and residential development in and around the many communities. Much of the existing TCH is accessed at-grade by local roads and highways, and driveways for farms, commercial establishments and residents. The existing TCH also serves as a major tourism route. It provides access to various attractions and facilities, and is a scenic route with numerous vistas to the river and its pristine valley, terrain and fall colours.

The current land uses have been identified from recent aerial photos, geographic information mapping and regulatory authorities, as well as baseline field studies and observation conducted for this CSR. Land use issues and concerns were received from property owners and stakeholders through a series of public meetings organized by NBDOT (Sections 2.0 and 4.0), as well as interviews conducted for this study with provincial and municipal government officials, recreation organizations, economic and business organizations and planning agencies.

The existing TCH extends north-south from Perth-Andover to Woodstock and traffic volumes range from 4,200 to 8,800 vehicles per day. The highest traffic volumes are in the vicinity of Woodstock where a large component of the traffic is local traffic. Approximately 3,000 to 3,500 vehicles per day originate and are destined outside the region. This traffic is pass-by or through traffic. After completion of the Project, through traffic will be diverted to the proposed TCH. The remaining traffic on the existing TCH will be comprised of locally oriented traveling within, or to and from the Project limits. This traffic will be split between the new TCH and the existing TCH. Traffic remaining on the existing TCH will be reduced to about 500 to 2,800 vehicles per day, depending on the extent of local usage (NBDOT 2002).

Trucks currently make up 27% to 34% of the total traffic along the existing TCH. Most trucks will be diverted to the proposed TCH, except those serving local industry and delivery.



5.8.4.1 Commercial Land Use

The Project proposes a new alignment for the TCH that extends over most of the distance between Perth-Andover and Woodstock. The existing commercial establishments within the spatial boundaries of the Project fall into three general categories.

- there are three commercial establishments located within the proposed Project RoW that will need to be removed or relocated.
- there are commercial establishments on the existing TCH that are focused on providing goods and services to the pass-by highway traffic exposure for some or all their business; and
- there are commercial establishments on the existing TCH that are not reliant on the highway traffic exposure for their business, but instead are either focused on the local markets or external markets outside the region.

Commercial establishments have been categorized according to interviews with municipal and private agency officials, as well as a windshield survey to identify commercial development along the existing TCH.

5.8.4.1.1 Proposed Project RoW

Three commercial operations in the Jacksonville area fall within the proposed Project RoW. Construction of the proposed TCH will require their removal. These include a recreational vehicle dealership, a home based business and a butcher shop.

5.8.4.1.2 Existing TCH Route

Woodstock/ Jacksonville Area

There are three commercial establishments located adjacent to the existing TCH at the Jacksonville interchange. They include a motel and restaurant operation, a recreational vehicle dealer and a trucking company. The motel and restaurant serves both the existing TCH traffic and the Woodstock area communities. The recreation vehicle dealer primarily serves the local area market, as well as some highway traffic. The trucking company is not reliant on pass-by existing TCH traffic. All three companies require highway access. The Project in this area is a twinned highway section that will entail the addition of two new lanes, but no change in the alignment or access for these businesses.



Jacksonville to Hartland

The proposed alignment will begin north of Jacksonville. The commercial establishments on the existing TCH between Jacksonville and Hartland include two service stations, two trucking companies and a golf course. Both service stations serve the existing TCH traffic, as well as the local area market. The golf course at Hartland is highly visible from the existing TCH. It serves the area residents and pre-planned visitors, and generates a small part of its business from passing travelers. The trucking companies provide regional and national services and are not reliant on exposure to highway traffic, but will require access to the proposed TCH.

Hartland

The Day and Ross trucking company terminal and a truck stop service station are located along the existing TCH at Hartland. Hartland has a number of commercial establishments on or adjacent to the existing TCH that cater to the highway traffic market. On the east side of the river, at the intersection of the existing TCH and Route 105 there are fast food outlets and a grocery store that were established to serve both the community and the highway traffic.

Hartland also has a number of other commercial establishments located within the community. These businesses include Day and Ross headquarters, accommodations, restaurants and retail outlets and serve both the Hartland visitors and highway traffic. The Hartland Covered Bridge, visible from the existing TCH, is a major attraction that draws traffic from the highway.

Hartland to Florenceville

Just north of Hartland, a motel is located on the existing TCH that is focused on serving highway traffic and visitors to the Hartland area. A hotel and restaurant facility is located in Florenceville on the existing TCH just south of the Saint John River bridge. This business serves both the Florenceville visitors and highway travelers.

Florenceville is a major agriculture centre and international headquarters to McCain Foods. There are a number of commercial establishments located along or adjacent to the existing TCH, including the McCain Foods plant, a trucking company and agriculture equipment companies. The trucking and the agriculture equipment companies serve local markets, and are not reliant on the highway traffic. McCain Foods ships frozen food products by truck to points throughout North America. It is not reliant on the existing TCH traffic market, but will require access to the proposed TCH to serve external markets.



Florenceville to Perth-Andover

This section of the existing TCH contains a number of commercial businesses. These include motels (2), campgrounds (2), service stations (2), restaurants (3) and stores (4). These businesses are primarily or partially focused on serving the highway traffic. There are a number of other businesses along the existing TCH that are mainly focused on providing service to local residents and businesses. These include vehicle repairs, auto parts store, wood working shop, Agriculture Centre and the NBDOT District Garage.

Perth-Andover

The proposed TCH will use the existing alignment and interchange at Perth-Andover. Two commercial establishments are located at the interchange. A motor inn is partially focused on serving the highway traffic market, in addition to pre-planned visitors to the area.

5.8.4.2 Residential Land Use

The selection of the proposed Project alignment by NBDOT attempted to minimize the environmental effects on residential properties. However, 34 properties containing houses or multiple unit residences fall within the RoW of the proposed TCH.

The highest number of affected houses is in the Jacksonville area (12). Other residential areas affected by the proposed Project include River De Chute (5), Bowmaster Flats (5), Sipperel Road (2), Backland Road (2), Raymond Road (1), Florenceville - Route 110 (2), B. Smith Road (1), Beaconsfield Road (1), Scott Road (1), and Perth-Andover (2). Agreements to purchase 27 of these residential properties have been successfully negotiated. The Provincial Government is continuing negotiations for the five Bowmaster Flats properties, and one each in the Jacksonville and the Beaconsfield Road areas.

The proposed Project alignment largely passes through forested lands, and avoids most residential areas. There are residences located along most of the local roads and highways that cross the proposed TCH, such as those noted above that have or are being removed and compensated.

Some other residences along these local roads and highways are located outside, but adjacent to, the proposed RoW. About 32 residences are located adjacent (within 200 m) to the proposed RoW.



5.8.4.3 Recreational Land Use

The land between the US border and the Saint John River from Woodstock to Perth-Andover is used for a range of recreational activities. The major activities include the use of an extensive off-road trail system used for bike riding, walking, snowmobiling and all-terrain vehicle (ATV) riding.

5.8.4.3.1 Trails

The trails include the following.

Sentier NB Trail/Trans-Canada Trail

Sentier NB Trail is part of a national trail system (Trans-Canada Trail) connecting all provinces and territories and a global trail organization. The Sentier NB Trail runs from Woodstock up the Saint John River Valley to Grand Falls. It is a multi-use trail, built on an abandoned Canadian Pacific Railway line. It is used for short walks and bicycle rides by residents and visitors, as well as multi-day trips on foot or bicycle.

This trail runs on the east side of the River, and does not cross or approach the proposed new TCH RoW.

International Appalachian Trail

The International Appalachian Trail is a hiking trail that runs from Southern US (Alabama) on up to Maine, New Brunswick, Quebec and will eventually be extended to Newfoundland. It enters New Brunswick at the Fort Fairfield border crossing (Route 190). It extends north to Four Falls, south along the Saint John River (NB Trail), and then heads up the Tobique River to Plaster Rock, Mt. Carleton, and back to St. Quentin. From there it follows the Restigouche River up to the Gaspé, Quebec.

The Appalachian Trail will cross the Aroostook to Grand Falls portion of the TCH at Four Falls, north of the Project limits from Perth-Andover to Woodstock. Access to the trail will be available at a number of points including Highway 190, the Four Falls interchange, Aroostook and Perth-Andover.

Snowmobile Trails

The New Brunswick Federation of Snowmobile Clubs (NBFSC) maintains a system of trails throughout the province. DNR has recently undertaken to map the known trails that are maintained by the Federation. According to the most recent data, there are six snowmobile trails which cross the proposed new four-lane highway rout (Figure 3.2 A-D, Appendix C).



ATV Trails

Several ATV clubs also maintain trails, many of which are part of the snowmobile trail network. Most of the trails are on the east side of the Saint John River. These trails have not been documented by the province. The use on snowmobile trails in spring, summer and fall and various woods roads by ATV's seem a logical assumption.

Level of Use

There is limited information available on the level of use of these trails. There have not been any surveys or traffic counts done for these trails. However, the 2001 Tourist and Parks survey (New Brunswick Department of Tourism and Parks 2001) of Saint John River Valley tourists indicated that 28 percent rated hiking and biking as a major interest. Wildlife viewing, a related activity, was also a popular activity of interest (23 percent).

Snowmobiling is clearly a major recreational activity in the Saint John River Valley. Between Woodstock and Grand Falls, there are six snowmobile clubs with 1,249 members who have paid for trail permits (NBFSC, pers. comm.). This would include trail users from other parts of the Province and out-of-Province visitors.

5.8.4.3.2 Hunting, Fishing and Trapping

Hunting and fishing are popular activities for Carleton County and Victoria residents and visitors. The Project is located within Wildlife Management Zone 10. Zone 10 runs from Grand Falls to Woodstock from the US border east to Plaster Rock and Juniper Station. Zone 10 is an active hunting area (NBDNRE 2003b) for deer (566 registered deer kills out of a provincial total of 6,443), black bear (125 kills out of provincial total of 1,905) and moose (65 kills out of a provincial total of 2,020). This hunting takes place on the wooded lands, both private and Crown land. This includes the private woodlots located along the proposed TCH and adjacent lands.

The recreational fishing activity occurs mainly in the two large watercourses crossed by the proposed TCH (K. Dickenson, DFO Woodstock, pers. comm.). These are the Big Presque Isle Stream (rainbow trout, brown trout and small mouth bass) and the Little Presque Isle Stream (small mouth bass and gaspereau). The other smaller streams and lakes also support other limited recreational fishing activity.

There are two recreational hunting and fishing outfitters located near the proposed TCH. These primarily provide outfitting and guiding services to non-local and out of province hunters (mostly for deer and bear hunting). These outfitters are located in the Centreville area. Their camps are not located on the proposed RoW, but some of the RoW is used for hunting activities.



There is some trapping activity within the proposed RoW and surrounding area for a range of furbearer species, such as fox, marten, fisher, beaver and bobcat. This is for recreation, commercial and animal control purposes.

5.8.4.4 Agriculture

Agriculture dominates the landscape through most of the Project area. Most of the agriculture production in Carleton and Victoria Counties is on the west side of the Saint John River and is potato or potato-related through crop rotation. The importance of this crop continues to grow and more and more land is being recovered, rejuvenated and placed into potato production.

There are 116 farm operations in the Statistics Canada 2001 Census Consolidated Subdivisions (CCS) in the area accounting for 5 percent of the provincial farm population representing:

- 12 percent of the Provincial field crop producers (potatoes, grain and oilseed, wheat, hay); and
- 5 percent of the Provincial beef cattle producers.

Potato land is being treated with careful rotational planning and is being regarded as the resource to covet above all others. The loss of land is considered important for the viability of a farming operation.

Based on individual stakeholder consultations, the consolidation of farms (combining several farms through acquisition or lease) has decreased the numbers of farmers but increased the size of farms substantially. With consolidation, cultivation can be oriented across several parcels of land creating large uninterrupted fields suited to large scale farming resulting in important industrial economies of scale, increased levels of sophistication in all aspects of production. New Brunswick's Average Yield is ranked second nationally in 2001 and in 2002 (NB Potato Statistics Update, B. Ouellette, DAFA, pers. comm.).

It is not uncommon for several traditional farms to be combined into one larger parcel and for a farm operation to have several separate large parcels often many kilometres apart and to see equipment on the move around the counties attending to fields on several parcels. The land ownership as depicted on property maps can therefore be misleading when it comes to appreciating the scale of agriculture.

Farms in the Assessment Area are larger operations, according to Statistics Canada (2001 Census, with 11 percent of the farms greater than 453 ha, as compared to 9 percent in Carleton County and 3 percent in the Province.

Larger parcels with larger fields with less fencing and associated windbreak vegetation create the potential for wind erosion.



The presence of agriculture and lack of forest cover is most evident in the area between Woodstock and Hartland. The same area between Woodstock and Hartland experiences drought conditions comparable to southern Manitoba. McCain Foods and other producers have explored and tried irrigation, which is needed but not yet economical for a number of reasons. Other smaller specialty producers have undertaken similar trials (J. Daigle, Eastern Canada Soil and Water Conservation Centre, pers. comm.).

The Canada Land Inventory (CLI) (Department of Forestry and Rural Development 1969) is a classification system developed to categorize soil capabilities by economic sector. Table 5.8.1 below summarized the CLI classification for agricultural production. According to the CLI the Project is located on lands of generally similar capability as those throughout the Assessment Area.

Table 5.8.1 CLI Soil Capability for Agriculture

CLI Soil Capability for Agriculture		Proposed Project Footprint		Assessment Area	
Class	Description	ha	%	ha	%
0	Organic Soils – Not placed in capability classes	0	0	1,019	1
1	Soils in this class have no significant limitations in use for crops	0	0	0	0
2	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices – moderately high to high in productivity for a fairly wide range of crops	180	17	13,518	17
3	Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices - fair to moderately high in productivity for a fair range of crops	292	28	20,199	26
4	Soils in this class have severe limitations that restrict the range of crops or require special conservation practices, or both – low to fair in productivity for a fair range of crops but may have higher productivity for a specially adapted crop	552	52	35,565	46
5	Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible – improvement practices may include clearing of bush, cultivation, seeding, fertilizing, or water	26	3	5,852	7
7	Soils in this class have no capability for arable culture or permanent pasture - this class also includes rockland, other non-soil areas, and bodies of water too small to be calculated on map	0	0	109	0
Water	Water	3	0	2,632	3
Totals		1,053	100	78,894	100

According to the CLI, the Project footprint has 97 percent Class 4 and better. In the Assessment Area, it is 90 percent, as compared to 48 percent in New Brunswick. Clearly the vicinity of the Project has very productive agricultural land, which is reflected in the intensive management and the associated land values.



CLI capability classes are national and consider sub-soil, soil profiles and depth, moisture, climate, slope, vegetation and do not consider modern cultivation practices. The land capability, which is well above the provincial average, could be even better than suggested by the CLI.

The Project footprint is 21 percent (223 ha) agriculture while the immediate surrounding area (20 map tiles) is 37 percent, which reflects how well agricultural lands were avoided through route selection. The Project footprint represents 0.8 percent of the Assessment Area.

Based on individual stakeholder consultations, a major portion of both potato and beef productions are shipped to the US or central Canada and are highly dependent on timely and efficient transportation. Potatoes are low priced commodity and are sensitive to time to market for product freshness. (P. MacDonald, Potatoes NB, pers. comm. 2003).

Conservation

Agriculture is experiencing a heightened environmental awareness aimed at water quality and soil conservation. The following represent some important initiatives in this regard.

The *Livestock Operations Act* requires a site development plan outlining (among other things) the proximity of a facility and related activities to other facilities and to dwellings, watercourses and wetlands and other environmentally sensitive areas with mitigating measures.

The Agriculture Environment Management Initiative 2003 produced by the New Brunswick Department of Agriculture, Fisheries and Aquaculture (NBDAFA 2003) is intended to facilitate the conservation and enhancement of the natural resource used by the NB agriculture sector and to minimize its environmental effects on the environment. There are seven programs in the initiative:

- nutrient management;
- on-farm stewardship;
- soil conservation;
- integrated pest management;
- livestock odour reduction;
- agro-environmental club; and
- strategic initiatives.

Producer organizations have also embraced the furthering of BMPs respecting the environment and soil productivity. The mission of the Soil and Crop Improvement Association is to Pioneer and advance leading soil and crop practices in New Brunswick. The Agriculture Producers Association of New



Brunswick coordinates the Environmental Farm Plan (31 percent of producers in Carleton County and 60 percent in Victoria County) have begun the process.

The Prince Edward Island *Agricultural Crop Rotation Act* deals with crop rotation and with land cultivation practices on slopes greater than 9 percent. Similar legislation is anticipated in New Brunswick that will require crop rotation (1-year potato, 2 years other) and soil conservation measures on slopes greater than 9 percent (for example terracing removes approximately 5 percent of the land from production). These initiatives would, if implemented as anticipated, in the short term, effectively reduce potato production area, hence increasing the demand to create more land suited for potato production in the future. Land for potato production is often created through converting forest land to agriculture.

5.8.4.5 Forest Resources

The Project footprint is almost 70% forestland. Table 5.8.2 shows the forest within the Project footprint is predominately hardwood and mixed wood and generally representative of the forest cover in the Assessment Area.

Table 5.8.2 Forested Area, Project Footprint Assessment Area

Forest Cover Type	Project Footprint		Assessment Area	
	%	ha	%	ha
Hardwood	25	263	16	12,623
Mixed Wood	33	348	23	18,145
Softwood	11	116	11	8,678
Total Forested	69	727	50	39,446

(1996 and 2000 Digital Forest Data (NBDNR))

The age class distribution of the forest based on NBDNR digital data is presented in Table 5.8.3. This table reveals that more than half of the forest in both the Project area and the Assessment Area are in the regenerating to immature stages of development. It was commented during stakeholder consultations that the digital data for their area typically under estimates the development stage (*i.e.*, Forest stands are typically older than the digital data present). This has not been confirmed in this study.



Table 5.8.3 Forested Area, Project Footprint Assessment Area

Forest Stand Development Stage	Project Footprint		Assessment Area	
	%	ha	%	ha
Regeneration	8	61	6.5	2,487
Sapling/Young	38	282	33	13,127
Immature	25	186	30	11,772
Mature	27	200	30	11,497
Overmature	1	6	1.5	564
Total Forested	99	735	99	39,447

(1996 and 2000 Digital Forest Data (NBDNRE))

The forestland in the Project footprint is entirely private woodlots and industrial freehold. Private woodlots are forest lands owned by individuals and/or timber harvest contractors while industrial freehold land are owned by businesses that own forest product processing facilities such as sawmills or pulp and paper mills. Of the forestlands within the Project footprint, 11 percent are industrial freehold. Table 5.8.4 below summarized the CLI classification for forest tree growth.

Table 5.8.4 CLI Soil Capability for Forestry

CLI Soil Capability for Agriculture		Proposed Project Footprint		Assessment Area	
Class	Description	ha	%	ha	%
3	Lands having moderate limitations to the growth of commercial forests (5.6 m ³ /ha/yr in productivity)	849	81	37,988	48
4	Lands having moderately severe limitations to the growth of commercial forests (4.2 m ³ /ha/yr in productivity)	137	13	33,109	42
5	Lands having severe limitations to the growth of commercial forests (2.9 m ³ /ha/yr in productivity)	65	6	4,083	5
6	Lands having severe limitations to the growth of commercial forests (1.4 m ³ /ha/yr in productivity)	0	0	1,098	1
Water	Water	33	0	2,616	3
Totals		1,084	100	78,894	99

(Department of Forestry and Rural Development 1967)

According to the CLI a larger percentage of the Project footprint is located on Class 3 forest lands that are the most productive in the Assessment Area.

Based on the NBDNR digital forest mapping data, the most common commercial tree species within the Project footprint are two hardwoods, poplar (*Populus* spp.) and sugar maple (*Acer Saccharum*), followed by eastern white cedar (*Thuja occidentalis* L.) and balsam fir (*Abies balsamea* (L.) Mill).



Silviculturally treated areas in the Project footprint include 12.6 ha of softwood plantations and 1.6 ha of commercial thinning. It is likely that there are areas of Pre-commercial thinning within the Project footprint that do not show up in the digital data because of the difficulty in identifying its presence by photo-interpretation.

5.8.5 Environmental Effects Analysis

NBDOT presented an initial routing and layout for a new TCH in 1998 through a series of public meetings. It then revised its plans to address a number of concerns related to the environmental effects on agricultural land, land access and traffic. In 1999 NBDOT presented a revised plan that addressed many of the concerns about the initial plan. In June 2003, NBDOT again presented the proposed revised plan at public meetings (June 24, 25, and 26), and have subsequently prepared the final proposed alignment, as described in Section 3.0 of this report.

Land use issues were considerably mitigated by the decision to construct the Project along a new by-pass alignment rather than twinning the existing route. This avoided most residential and commercial areas, and farmland disruption. In addition, the successive improvements to the by-pass alignment plans by NBDOT in consultation with the public led to the proposed alignment that is the basis of this environmental assessment. Section 2.2 provides details of how public concerns and issues were addressed in the route selection process.

5.8.5.1 Project-VEC Interactions

The potential interactions between Project activities and the Land Use VEC are indicated in Table 5.8.5 for each Project phase, and accidents, malfunctions and unplanned events. The nature of these interactions is summarized in the following sections that address the potential environmental effects of each Project activity.

Table 5.8.5 Project Activity - Environmental Effects Interaction Matrix - Land Use

Potential Interactions Between Project Activities and Environmental Effects					
Valued Environmental Component: <u>LAND USE</u>					
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects				
	Change in Residential Land Use	Change in Commercial Land Use	Change in Recreational Land Use	Change in Forest Resource Land Use	Change in Agricultural Land Use
Construction					
Site Preparation	✓	✓	✓	✓	✓
Roadbed Preparation	✓		✓		
Surfacing and Finishing	✓		✓		
Watercourse Crossing Structures	✓		✓		
Ancillary Structures and Facilities	✓		✓	✓	✓
Operation					



Table 5.8.5 Project Activity - Environmental Effects Interaction Matrix - Land Use

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>LAND USE</u>					
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects				
	Change in Residential Land Use	Change in Commercial Land Use	Change in Recreational Land Use	Change in Forest Resource Land Use	Change in Agricultural Land Use
Winter Safety				✓	✓
Proposed TCH Presence	✓	✓	✓		
Maintenance					
Proposed TCH Maintenance	✓	✓			
Vegetation and Wildlife Management					
Accidents, Malfunctions and Unplanned Events					
Construction	✓	✓	✓	✓	✓
Operation	✓	✓	✓	✓	✓
Maintenance	✓	✓		✓	

5.8.5.1.1 Construction

The interaction of the environmental effects of the construction activities and physical works of the Project with the Land Use VEC is summarized in Table 5.8.5 and described below.

Commercial Land Use

There were three commercial businesses in the Jacksonville area that were located within the proposed RoW. These businesses have already re-located. These business operations include a recreational vehicle dealership, a home based business and a butcher shop.

Residential Land Use

The Project construction will require the purchase and/or relocation of 34 residential buildings, as identified previously in Section 5.8.4.

About 32 residences are located adjacent (within 200 m) to the proposed RoW. The residents of these houses are likely to experience a perceptible change in noise levels from the construction equipment during all phases of construction of the proposed TCH. Residents may also be affected by air emissions and other disturbances generated by the Project. These issues and environmental effects are addressed in detail in Section 5.1 Atmospheric Environment.



Recreational Land Use

The recreational land uses in the vicinity of the Project include hiking, bicycling, snowmobiling, all-terrain vehicle (ATV) use, hunting and fishing. Hiking, bicycling, snowmobiling and ATV use takes place on established trails, as identified in the existing conditions Section 5.8.4. The Project will intercept six NBFSC trails that cross the proposed RoW (figure 3.2, Appendix C).

The Project is within Wildlife Management Zone 10, which is an active area for hunting and fishing. The forested lands are used for hunting as are the major watercourses for fishing. There are two hunting and fishing outfitting operations located on adjacent lands. The two outfitters in the area, Deerville Camps (Deerville) and Knoxford Lodge (Upper Knoxford) raised their concern that the Project will reduce the land available for hunting. Knoxford Lodge was concerned that the Project would reduce the already limited woodlands in its area. Both outfitters supported the Project but regretted the potential environmental effect it would have on the recreational hunting in the area. These camps will not be affected by the Project but the construction phase will result in a loss of land available for hunting by resident and non-resident hunters.

Construction activities at watercourse crossing will result in restriction (for safety) to recreational fishing at the construction site only.

Construction activities will temporarily affect recreation trail land use in the immediate vicinity of the Project due to noise, dust and other minor disturbances during all Project activity phases and physical works.

Forest Resource Land Use

Landowners whose property will be affected by the project in regards to access to the forest resources will be compensated for the loss of that land/resource.

Most of the environmental effects to the forest resource will occur or be initiated during site preparation. The potential environmental effects centre around the removal of forest land base resulting in a loss of production to the landowner and forest cover in general. During the site preparation stage of construction the following adverse changes to the forest resources will occur:

- landowners will lose ownership of a portion of their land holdings;
- based on the Project footprint, 735 ha of forest land will be cleared;
- approximately 33,000 m³ of softwood and 42,500 m³ of hardwood will be harvested and enter the commercial forest products market;
- approximately 340 ha of young/regeneration and 186 ha of immature forest stands will be cleared resulting in a loss of unmerchantable future wood resources;



- woodlots will be severed, resulting in the potential for economically in-operable remnant parcels; and
- silviculturally treated areas (plantations and thinnings) will be cleared resulting in a loss of investment made by woodlot owners.

Although some of these environmental effects will continue in perpetuity, these environmental effects are mitigated in the Construction Phase of the Project and are therefore considered only in the Construction phase of the EA.

Other adverse environmental effects may be caused by altered transportation routes during construction to parts of woodlots being interfered with during construction of the proposed TCH.

Agricultural Land Use

Landowners whose property will be affected by the project in regards to agricultural resources will be compensated for the loss of that land/resource.

Most of the environmental effects to the agriculture resource will occur or be initiated during the site preparation phase of construction. The environmental effects centre on the removal of and/or access to agricultural land resulting in a loss of production to the landowner. Potential adverse changes to the agriculture resources during site preparation are described below.

Based on the proposed alignment, 223 ha of agricultural land, recently developed agricultural land or infrastructure will be removed from production. Portions of farm operation will be severed, resulting in the potential for economically in-operable remnant parcels; landowners will lose ownership of those portions of their land holdings so affected resulting in a loss of productive capacity of the farm.

Although some of these environmental effects will continue in perpetuity, these environmental effects are mitigated in the Construction Phase of the Project and are therefore considered only in the Construction phase of the EA.

Portions of farm operations will be severed, resulting in environmental effects caused by transportation and access routes to agricultural land being disrupted or interfered with during construction. This could potentially reduce the economic operability of severed parcels.

Ancillary structures and facilities required for construction (e.g., borrow pits, disposal areas) may interfere with various land uses due to loss of use, or temporary interference with use.



5.8.5.1.2 Operation

The Project-Land Use VEC interactions of the operation phase of the Project are summarized in Table 5.8.5 and described below.

Commercial Land Use

When the Project commences operation, the presence of the proposed TCH will create a shift in traffic from the existing TCH. Approximately 3,000 vehicles per day, including most trucks, of through traffic will be diverted from the existing TCH to the proposed TCH. This is expected to affect some businesses located along the existing TCH in terms of reduced traffic exposure and business activity.

Residential Land Use

A number of residents located outside the RoW, but adjacent to the proposed Project have expressed concern that they will be adversely affected by the presence and operation of the proposed TCH due to traffic noise, air emissions and other disturbances. There are 32 households within 200 m of the proposed RoW that are likely to be affected by the traffic noise generated by the proposed TCH. These potential environmental effects are addressed in more detail in Section 5.1 Atmospheric Environment.

Residences along the existing TCH are expected to experience a reduction of traffic once the Project is constructed. This will likely improve the level of service and safety along the existing TCH and will reduce traffic noise to residents along the existing TCH.

Recreational Land Use

The presence of the proposed TCH traffic will affect recreational land use benefits due to noise and other minor disturbances in the immediate vicinity of the Project. However this will only occur while crossing the proposed RoW, as the trails and most recreation activities are located away from the Project.

Forest Resources Land Use

During the winter, NBDOT will use salt. This has the potential to damage tree foliage along the edge of adjacent forest. The damage can occur during thaws when salt spray or during drier periods when salt dust can be blown onto trees close to the proposed TCH.



Loss of productive forest land initiated during clearing will continue for the duration (in perpetuity) of the Project, however, mitigation and compensation are addressed in the Construction Phase of the Project.

Operating costs may increase for some landowners because of the proposed TCH, either because of having to transport forest products longer distances or having to float (move) equipment to separate work locations. These costs may be somewhat offset by the benefits of having a four-lane highway for access to markets at higher speeds, better grades and 100% weight limits.

Agricultural Land Use

During the winter, NBDOT will use salt that can contaminate soil along the edge of adjacent agricultural land through salt spray during thaws or through salt dust during drier periods.

Most of the environmental effects to the agriculture resource will be initiated during site preparation and continue for the life of the Project, however, mitigation for this loss is addressed in the Construction Phase of the Project.

The Project may cause cold air pooling which may in turn affect the ability to grow certain crops. This potential environmental effect is discussed in Section 5.1.5.1.

Operating costs may increase for some landowners, either because of having to transport products longer distances or having to move equipment and material (e.g., fertilizer) to separate work locations during the production season.

During Operation the following positive/beneficial changes to the agriculture resources will occur:

- traffic along the old TCH will be greatly reduced making it much more agriculture-friendly especially during the growing and harvesting season that requires regular movement of machinery from site to site; and
- two of the principal agriculture productions (potato and beef) are highly dependent on efficient transportation for both cost and time to market (freshness), both of which will be realized as a result of the project.

5.8.5.1.3 Maintenance

The Project-environmental interactions during Maintenance are summarized in Table 5.8.5 and described below.



Proposed TCH maintenance, such as road repairs and resurfacing may adversely effect residents adjacent to the proposed Project due to noise and other atmospheric disturbances. This would only be a concern during major maintenance, such as resurfacing or bridge reconstruction.

5.8.5.1.4 Accidents, Malfunctions and Unplanned Events

The Project-VEC interactions that may result from accidents, malfunctions and unplanned events are summarized in Table 5.8.5 and described below.

Residential and Commercial Land Use

Accidents, malfunctions and unplanned events have the potential to adversely affect residential and commercial land use. These could occur during construction, operation and maintenance phases of the Project. Potential incidents include major vehicle accidents, fire, and contaminant spills that could affect air or water quality, and could result in a requirement to evacuate properties, property damage, injury or loss of life.

Recreational Land Use

Accidents, fires, other malfunctions and unplanned events could affect recreational land use due to noise, restricted access, odour and other factors. These could occur during construction, operation and maintenance phases of the Project. However, recreation activities, such as the use of recreation trails do not occur within the proposed RoW, except to cross it. This will reduce the likelihood of such incidents.

Forest Resources

During all of the Project activities there is a risk of forest fires being started from either the highway construction workers or highway users. The greatest risk of fire is during site preparation and subsequent construction activities. During the operation of the proposed TCH, the risk of fire is related to weather, roadside vegetation management and human error (cars parking in the grass or smokers carelessly discarding burning embers).

Based on stakeholder consultations with the CVFPMB and field staff observations, an unplanned event that has already occurred and continues to occur is timber harvesting incremental to the Proposed TCH. Either the landowners are having their forest lands harvested by a contractor or doing the harvesting themselves, in anticipation of the proposed TCH development. When retaining a harvesting contractor, a small portion of landowners are having the RoW and adjacent forest stands cut at the same time, to minimize costs and to avoid perceived issues of access in the future.



Agricultural Resources

During all of the Project activities there is a risk of accidents, malfunctions and unplanned events. They are for the most part temporary and reversible. The principle events during Construction activities are construction related traffic congestion on the old TCH, particularly during the growing and harvesting season or are livestock related. There is the potential to disrupt the water supply for livestock operations or for livestock to otherwise experience stress and loss of production during construction.

Livestock feed lots contain concentrations of animal manure that can contaminate water during removal and storage. This is addressed in relation to Surface Water (Section 5.3)

During all Project activities there is a risk of spring grass fires being started from either the highway construction workers or highway users. The greatest risk of fire is during site preparation and subsequent construction activities. During the operation of the proposed TCH the risk of fire is related to weather, roadside vegetation management and human error (cars parking in the grass or smokers carelessly discarding burning embers).

5.8.5.2 Environmental Effects Analysis and Mitigation

5.8.5.2.1 Construction

The activities associated with the construction of this Project may have an effect on Land Use in the Project area. The sections following Table 5.8.6 describes the strategies aimed at mitigating these potential environmental effects.

Table 5.8.6 Environmental Effects Assessment Matrix for Land Use (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in Residential Land Use (within RoW) (A)	• Purchase properties within RoW	2	1	5/1	1	2
	Change in Residential Land Use (Adjacent to RoW) (A)	• Dust Control • Work Progression	1	1	1/6	R	2



Table 5.8.6 Environmental Effects Assessment Matrix for Land Use (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
	Change in Commercial Land Use (A)	• Purchase properties with RoW	2	1	5/1	1	2
	Change in Recreational Land Use (A)	• Ensure trail continuity • Dust control • Erosion and sedimentation control • Work Progression	1	1	1/6	R	2
	Change in Forest Resources Land Use (Land taken out of production) (A)	• Land Acquisition: Open and early communication with landowners • Time (as construction schedule permits) for landowner to exercise clearing options • Compensation for market value of land • Provision of access to severed properties negotiated, where necessary	1	2	2/1	1	2
	Change in Agricultural Land Use (Land taken out of production) (A)	• Land Acquisition: Open and early communication with landowners • Compensation for market value of land • Provision of access to severed properties negotiated, where necessary	2	2	5/6	1	2
Roadbed Preparation	Change in Residential Land Use (Adjacent to RoW) (A)	• Dust Control • Work Progression	1	1	1/6	R	2
	Change in Residential Land Use (Within RoW) (A)	• Compensation at fair market value	1	1	5/6	R	2
	Change in Recreational Land Use (for hunting) (A)	• Wildlife collision measures (fencing crossings etc.) • See Wildlife VEC Section 5.7	1	2	1/6	R	2
	Change in Recreational Land Use (for trails) (A)	• Dust Control • Erosion and sedimentation control • Work Progression	1	1	1/6	R	2
	Change in Forest Land Use (Operations) (A)	• Reasonable accommodations made to allow forestry operations access to adjoining lands during construction	2	2	4/2	R	2

Table 5.8.6 Environmental Effects Assessment Matrix for Land Use (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Surfacing and Finishing	Change in Residential Land Use (Adjacent to RoW) (A)	- Dust Control - Work Progression	1	1	1/6	R	2
	Change in Recreational Land Use (for hunting and for trails) (A)	- Dust Control - Erosion and sedimentation control - Work Progression	1	2	1/6	R	2
Watercourse Crossing Structures	Change in Residential Land Use (Adjacent to RoW) (A)	- Dust Control - Work Progression	1	1	1/6	R	2
	Change in Recreational Land Use (for hunting and for trails) (A)	- Dust Control - Erosion and sedimentation control - Work Progression	1	2	1	R	2
Ancillary Structures and Facilities Construction	Change in Residential Land Use (Adjacent to RoW) (A)	- Dust Control - Work Progression	1	1	1	R	2
	Change in Recreational Land Use (for hunting and for trails) (A)	- Provide trail continuity - Dust Control - Work Progression - Erosion and sedimentation control	1	2	1	R	2
	Change in Forest Resource Land Use (Land taken out of production) (A)	- Land Acquisition: Open and early communication with landowners - Time (as construction schedule permits) for landowner to exercise clearing options - Compensation for market value of land - Provision of access to severed properties negotiated, where necessary	1	2	2/1	I	2
	Change in Forest Land Use (Operations) (A)	Provision of access to severed properties negotiated, where necessary	2	2	4/2	R	2
	Change in Agricultural Land Use (Land taken out of production) (A)	- Land Acquisition: Open and early communication with landowners - Compensation for market value of land - Provision of access to severed land	2	2	5/6	I	2
	Change in Agricultural Land Use (Operation) (A)	Provision of access to severed properties negotiated, where necessary	1	2	5/6	R	2



Table 5.8.6 Environmental Effects Assessment Matrix for Land Use (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Construction</u>						
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Key: Magnitude: 1 = Low: e.g., specific group, residence or neighbourhood affected such that adjacent land use activities will not be disrupted such that current activities cannot continue even after short periods of time. 2 = Medium: e.g., part of a community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended period of time longer than two years. 3 = High: e.g., community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended periods of time longer than two years and are not compensated for. Geographic Extent: 1 = < 1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Frequency: 1 = <11 events year 2 = 11 - 50 events year 3 = 51 - 100 events year 4 = 101 - 200 events year 5 = >200 events year 6 = continuous Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive						

Commercial Land Use

The removal of the three businesses from the proposed RoW is required to allow the Project to proceed along the proposed route. The planned mitigation measure is the purchase of the commercial properties at fair market prices agreeable to the existing owners and removal of all buildings and other improvements. Commercial activity is not a major land use within the proposed RoW in terms of the number of businesses and area of land. The existing commercial businesses have relocated already under agreement with NBDOT.

Residential Land Use

The Project will result in the elimination of any residential land use within the proposed RoW. The mitigation program for elimination of residential land use entails purchasing the properties, to allow the owners to relocate to another residence elsewhere. The purchase agreements are negotiated on a case by case basis to address the specific interests, concerns and circumstances of the residents affected.

The Project will require the removal of 34 residential buildings from the proposed RoW. The Provincial Government is negotiating agreements to purchase these properties. The purchase price and other provisions of compensation agreements reflect market values for the properties and any improvements,



as well as the cost and availability of alternative accommodation and relocation expenses. Suitable alternative residential properties are available in the area to address the needs of those affected.

Negotiations are ongoing for the remaining properties, as part of the RoW preparation phase of the construction. The provisions of the *Expropriation Act* will be used to acquire the properties. This Act provides for compensation based on the market value of the land, damages attributable to disturbance, and any special economic advantages or disadvantages arising from the occupation of the land. Where the payment of market value would create hardship for the owner, the Act provides for additional payments to allow the owner to obtain equivalent accommodation.

Although clearly a considerable inconvenience for property owners, mitigation is designed and should be effective in compensating home owners for that inconvenience.

Residential land use along local roads and highways adjacent to the proposed RoW will be affected during the construction of the Project due to noise, air emissions and dust generated by truck traffic and construction equipment. About 32 residences are located adjacent (within 200 m) to the proposed RoW. Mitigation measures include application of dust control methods and work progression specifications to ensure construction activity scheduling is met and duration minimized. These environmental effects are addressed in Section 5.1 Atmospheric Environment.

Recreational Land Use

The main potential environmental effect of the Project on recreational land use during construction is the intersection of recreational trails that are used for hiking, biking, snowmobiling and other activities. Trail users would be exposed to noise, dust and other disruptions during construction temporarily affecting the quality of experience of trail users. Consultation with recreation organizations identified one established hiking/biking trail and six snowmobile (ATV) trails that intersect the proposed RoW. There may be other recreation trails in the area that could be affected. However, no other trails have been identified as established and maintained trails by the various recreational organizations.

Potential mitigation measures during construction are to identify established recreational trails and develop approaches to ensure the continuation of trail access for recreational users. In addition dust and erosion controls and work progression scheduling can be specified in construction contracts to minimize potential environmental effects on trail use during construction activities.

The design of the proposed TCH will provide for the construction of trail access through the use of signage, tunnel underpasses or other means.



There may be temporary interruption to recreational fishing at the immediate location of some of the watercourse crossings (e.g., Big Presque Isle River), as for safety reasons public access to the river will be restricted. This interruption will only affect a very small portion of these watercourses and will be temporary.

Forest Resource Land Use

During site preparation most of the environmental effects to the forest resource will occur or be initiated. The environmental effects centre on the removal of and/or access to forest land base during construction resulting in a loss of production to the landowner and forest cover in general.

Market Value

The primary mitigation for productive forestland loss is through compensation of landowners for both the lands acquired, used or otherwise affected by the proposed TCH, and the forest resource on those lands. The compensation process will take into account a broad range of issues such as land use, forest resources, remnants and severances. Landowners will be clearly and consistently informed as to their rights, options and the methods of valuation as they pertain to the New Brunswick Expropriation Act and NBDOT's methods of valuation and negotiation.

There are situations whereby landowners may elect to harvest or arrange to have that portion of the property harvested rather than receive compensation for standing timber to be cleared and NBDOT will attempt to ensure that there is adequate time for the landowner to organize and implement clearing options in a timely manner consistent with existing operations.

Additional cost associated with accessing severed land parcels will be off-set by the benefit of having better access to markets at better grades, higher speeds and 100% weight limits. 735 ha of formerly forested lands will be removed from future production. Based on CLI data, this represents an annual withdrawal from the productive forest land base representing approximately 3,900 m³/year or 1.2% of the Carleton-Victoria Forest Products Marketing Board (CVFPMB) annual volume from private lands.

Access to Forest Lands

Recognizing that the construction of the proposed TCH and access roads will take two to three years to complete, NBDOT will also attempt to provide on-going forestry operations with access across the RoW throughout the construction period as safety and operational considerations permit.



Agricultural Land Use

During site preparation most of the environmental effects to the agriculture resource will occur or be initiated. The potential environmental effects centre around the removal of and/or access to agricultural land resulting in a loss of productive capacity and production by the landowner.

Land Acquisition and Agriculture Resource Values

As mentioned previously, the potential environmental effects occurring or originating during Construction centre around the access to and/or removal of agricultural land from production. Because some of the potential environmental effects will continue beyond the construction phase, the mitigation while initiated during construction, should reflect other phases of the Project. The primary mitigation is through landowner compensation for the lands acquired, used or otherwise affected by the proposed TCH. Two hundred and twenty-three hectares of formerly agricultural land will be removed from production as a result of the Project, however, this only represents 0.3% of the agricultural land in the Assessment Area.

Landowners will be clearly and consistently informed as to their rights, options and the methods of valuation and negotiation as they pertain to the *New Brunswick Expropriation Act* and NBDOT's compensation methods. Properties that are severed in such a manner that a remnant parcel precludes current land use will be mitigated through provision of compensation and or alternate access.

Farms are business/economic interests with land being the source of productive capacity. Those farm operations affected by the Project are also facing a business decision that is imposed on them by the proposed TCH. There are commonly situations whereby farm operators may wish to make adjustments to their operations. NBDOT will work with landowners to plan and accommodate those adjustments.

Not all land will be acquired by NBDOT. There will be properties that will be severed that are not acquired by NBDOT (called a severance) and recognizing that the construction of the proposed TCH and access roads may take several years to complete, on-going agricultural operations may need regular access across the RoW at certain periods of the year. Reasonable provisions will be considered to allow these operations to be conducted during construction as operational requirements permit.

Severed land may also represent an additional cost to the farm through the regular movement of equipment, material and crops. For properties that are severed in such a manner that a severance results in additional operational costs, NBDOT will negotiate fair compensation.

Additional cost associated with accessing severed land parcels will be off-set by the benefit of having better access to markets at better grades, higher speeds and 100% weight limits.



For larger operations (often several consolidated properties), alternatives such as land exchanges to create land consolidations to maintain the farm unit's productive capacity and efficiency should be explored.

Summary - Construction

The potential environment effects of Project related construction activities on Land Use in consideration of the characteristics of those potential environmental effects and planned mitigation are considered not significant.

5.8.5.2.2 Operation

The potential environmental effects of the Project operation on Land Use are characterized in Table 5.8.7. The following provides a detailed discussion of these potential environmental effects during the Operation phase of the Project, including mitigation.

Table 5.8.7 Environmental Effects Assessment Matrix for Land Use (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in Forest Resource Land Use (Salt damage to forest trees adjacent to highway) (A)	- Fair compensation for damaged trees - Adherence to EPP	1	1	5/3	R	2
	Change in Agricultural Land Use (Salt damage to agricultural land adjacent to highway) (A)	- Fair compensation for damaged farm land - Adherence to EPP - Suitable buffer/distance from salt source	1	1	3/3	R	2
Proposed TCH Presence	Change in Residential Land use (Adjacent to RoW) (A)	Monitor noise	1	1	5/6	R	2
	Change in Residential Land use (Along existing TCH) (P)	None required	2	3	5/6	R	2
	Change in Commercial Land Use (P)	None recommended	1	1	5/6	R	2
	Change in Recreational Land Use (for trails) (A)	Ensure trail continuity	1	1	5/6	R	2



Table 5.8.7 Environmental Effects Assessment Matrix for Land Use (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Operation</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
	Change in Recreational Land Use (for hunting) (A)	Wildlife collision measures (fencing and crossing)	1	2	5-6	R	2
Key: Magnitude: 1 = Low: e.g., specific group, residence or neighbourhood affected such that adjacent land use activities will not be disrupted such that current activities cannot continue even after short periods of time. 2 = Medium: e.g., part of a community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended period of time longer than two years. 3 = High: e.g., community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended periods of time longer than two years and are not compensated for. Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = > 10,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = > 72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = > 200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Commercial Land Use

Once constructed, the presence of the proposed new TCH is expected to attract new commercial development adjacent to the proposed RoW (primarily at interchanges) to provide goods and services to the highway users. Identified developments include major highway service centres at Perth-Andover and Grand Falls. These developments are taking place outside the proposed RoW near the interchanges and are subject to existing municipal and provincial land use regulations and plans. It is expected that other developments will take place, but have not been identified to date. This commercial development is considered a positive effect on the economy and no mitigation or enhancement measures are proposed.

The loss of business to businesses along the existing TCH due to traffic diversions is considered an economic rather than a land use environmental effect, and is addressed in the Labour and Economy VEC (Section 5.11).

Residential Land Use

Residential land use adjacent to the proposed RoW may be adversely affected during the operational phase of the Project due to noise, air emissions and other disturbances from the passing traffic on the



proposed TCH, as well as local roads and highways used for access. According to the survey of existing sound levels, and the forecasts of traffic noise with the proposed TCH, conducted for the Atmospheric Environment VEC assessment, there are about 32 houses located within 200 m of the proposed RoW that are likely to experience a perceptible change in sound level. A detailed assessment of these environmental effects and possible mitigation measures are addressed in Section 5.1 Atmospheric Environment.

Many residences are located along the existing TCH. Upon completion of the proposed TCH, most through vehicular and truck traffic along the existing TCH will be diverted to the proposed TCH. This is expected to reduce the traffic noise, air emissions and other disturbances to residents, as well as improve traffic safety along the existing TCH.

Residents along the existing TCH will be positively affected by the diversion of heavy trucks and through traffic to the proposed TCH, which will improve safety and level of service. No mitigation or enhancement measures are necessary.

Recreational Land Use

The potential environmental effect of the Project on recreation during the operation phase is the same as was described for the construction phase, but will continue in perpetuity. There are other recreational trails in the area that may possibly be affected.

Mitigation measures for trails during operation of the Project will include measures that ensure the continuity of trail access through the use of signage, tunnel underpasses or other means. As can be seen in Figure 3.2 (A-D) Appendix C, two of the snowmobile trails cross the new highway at overpasses. The continuity of the Provincial snowmobile trail system will be ensured via the provision of a crossing. Crossings will not be provided for local trail systems. However, riders may legally cross highways at their own risk.

Hunting activity will be eliminated within the RoW and on immediately adjacent lands due to displacement of wildlife (avoidance) and loss of habitat, and the restricted hunting area requirements for firearm operations. Mitigation measures for recreational hunting include provision of wildlife fencing and/or crossings to prevent wildlife losses by avoiding highway collisions with wildlife. Environmental effects of the Project operations on wildlife are addressed in Section 5.7 Wildlife.



Forestry Resources Land Use

During the winter, salt will be used and has the potential to damage tree foliage along the proposed RoW in small and isolated area. Damage is generally reversible however product value may be affected (e.g., Christmas trees).

The Primary mitigation for salt damage is in the design of the Project whereby the width of the RoW will likely provide a suitable buffer between the source of the salt and vegetation and the adherence to the EPP Section 6, which specifies application rates as per the Highway Maintenance Management System Manual, which seeks maximum effectiveness and minimizing salt requirements.

In instances where salt damage has caused trees to die or to be rendered non-merchantable (e.g., Christmas trees), fair and reasonable compensation for damaged trees will be negotiated.

Agricultural Land Use

During the winter months salt used on the TCH can contaminate agricultural land through salt spray during thaws or through salt dust during drier periods. Exposure to these conditions is likely to be in small and isolated areas. Damage is generally temporary, however product value may be affected.

The Primary mitigation for salt damage is in the design of the Project whereby the width of the RoW provides a suitable buffer between the source of salt and agricultural land. Also, the adherence to the EPP, Section 6, which specifies application rates as per the Highway Maintenance Management System Manual, will ensure maximum effectiveness and minimize salt requirements.

In instances where salt damage has caused crops to fail, fair and reasonable compensation for damaged crops will be negotiated.

Summary - Operation

Based on the consideration of the environmental effects of the individual activities required to operate the proposed TCH and the proposed mitigation, and in consideration of the residual environmental effects rating criteria, the residual environmental effects on Land Use are considered not significant.

5.8.5.2.3 Maintenance

Table 5.8.8 provides the environmental effects analysis matrix for Maintenance activities of the Project including mitigation.



Table 5.8.8 Environmental Effects Assessment Matrix for Land Use (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LAND USE</u> Phase: <u>Maintenance</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Maintenance	Change in Residential and Commercial Land Use (A)	• None recommended	1	1	1	R	2
Key: Magnitude: 1 = Low: e.g., specific group, residence or neighbourhood affected such that adjacent land use activities will not be disrupted such that current activities cannot continue even after short periods of time. 2 = Medium: e.g., part of a community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended period of time longer than two years. 3 = High: e.g., community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended periods of time longer than two years and are not compensated for. Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Periodic maintenance will be required for the Project, such as resurfacing and reconstruction of roadbeds and structures. Typically, major resurfacing of roadways takes place about every fifteen years. Bridges and major structures have longer structural refurbishment periods. These maintenance activities would create additional noise and dust which could affect adjacent residential and commercial land use. This issue is addressed in Section 5.1 Atmospheric Environment.

Major maintenance could affect recreational land use due to noise, dust and other disturbances. The infrequency and short duration of these disturbances do not warrant additional mitigation measures. Maintenance is not likely to affect forestry and agricultural operations in any substantive way.

The potential environmental effects of Project maintenance on Land Use are, in consideration of planned mitigation, considered not significant.

5.8.5.2.4 Accidents, Malfunctions and Unplanned Events

The potential environmental effects on Land Use that could occur as a result of accidents, malfunctions and unplanned events are characterized in Table 5.8.9. Potential mitigation measures during Project



operation are also provided. The following provides a detailed discussion of these potential environmental effects.

Table 5.8.9 Environmental Effects Assessment Matrix for Land Use (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: LAND USE Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Construction	Change in Residential and Commercial Land use (A)	- Adherence to applicable health and safety legislation - Emergency response plans	1	1	1/1	R	2
	Change in Recreational Land Use (A)	- Adherence to applicable health and safety legislation - Emergency response plans	1	1	1/1	R	2
	Change in Forest Resource Land Use Forest Fires (A)	- EPP - NB Forest Fires Act: Regulation General - In progress monitoring by NBDOT inspectors	1 or 2	2	2/1	R	2
	Change in Forest Resource Land Use (A) Incremental Timber Harvesting	- Communication with landowners well in advance - Clarify to landowners that survey lines may change	2	2	3/3	R	2
	Change in Agricultural Land Use Fire (A)	- EPP - NB Forest Fires Act: Regulation General - In progress monitoring by NBDOT inspectors - Communication with landowners - Scheduling around peak agriculture movements	1 or 2	1 or 2	3/3	R	2
Operation	Change in Residential and Commercial Land use (A)	- Adherence to applicable health and safety legislation - Emergency response plans	1	1	1/1	R	2
	Change in Recreational Land Use (A)	- Adherence to applicable health and safety legislation - Emergency response plans	1	1	1/1	R	2
	Change in Forest Resource Land Use Forest Fires (A)	Roadside vegetation management as per EPP	1 or 2	3	3/3	R	2



Table 5.8.9 Environmental Effects Assessment Matrix for Land Use (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: LAND USE Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
	Change in Agricultural Land Use Fire (A)	- EPP - NB Forest Fires Act: Regulation General - Communication with landowners	1 or 2	1 or 2	3/3	R	2
Maintenance	Change in Residential and Commercial Land Use (A)	- Adherence to applicable health and safety legislation - Emergency response plans	1	1	1/1	R	2
Key: Magnitude: 1 = Low: e.g., specific group, residence or neighbourhood affected such that adjacent land use activities will not be disrupted such that current activities cannot continue even after short periods of time. 2 = Medium: e.g., part of a community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended period of time longer than two years. 3 = High: e.g., community affected such that adjacent land use activities will be disrupted such that current activities cannot continue for extended periods of time longer than two years and are not compensated for. Geographic Extent: 1 = <1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Residential and Commercial Land Uses

Accidents, malfunctions and unplanned events could have a range of environmental effects, including hazardous material spills to major vehicle accidents. One of the main purposes of the Project is to improve the safety of highway travel. However, traffic accidents are likely to occur on the proposed TCH, albeit at a lesser rate of incidence and severity than along the existing TCH (NBDOT 2002).

The mitigation measures include the enforcement of all applicable environmental, and health and safety laws during construction, operation and maintenance. Emergency response measures (e.g., fire, rescue, ambulance, spill response) will be developed to address a range of potential events. Additional discussion of hazardous material spills can be found in the Groundwater VEC (Section 5.2), the Surface Water VEC (Section 5.3), and the Fish and Fish Habitat VEC (Section 5.4).



Recreational Land Use

Accidents, malfunctions and unplanned events that could occur during construction, operation or maintenance of the Project may diminish the enjoyment/benefits of the recreational land use due to noise, dust, air emissions and other undesirable conditions. Given that the recreational activities within the proposed RoW are only for the purposes of accessing recreational lands on the other side, the environmental effects would be limited in magnitude and duration. Normal mitigation measures to minimize the environmental effects of the range of accident and unplanned events would be appropriate. These would include emergency response measures including fire, rescue, ambulance, and spill response.

Forest Resources Land Use

During all phases of the Project there is a risk of forest fires being started from either the highway construction workers or highway users. The greatest risk of fire is during the Site Preparation Stage and subsequent construction activities. The primary mitigation is through prevention and the EPP Section 4 that deals with environmental protection measures during construction that suggests a preference for conducting forest clearing during the winter months during which time forest fire hazards are reduced and includes obtaining a burning permit from NBDNR. Where winter harvests are not possible, fire protection equipment requirements must be consistent with those required on all forest operations in New Brunswick as specified within the *Forest Fires Act* and Section 7.4 of the EPP.

In all construction activities, NBDOT inspectors will monitor clearing and other relevant operations to ensure equipment is functional and personnel are trained in its safe use with respect to the prevention of fires.

During the operation of the proposed TCH the risk of fire is related to weather, roadside vegetation management and human error (cars parking in the grass or smokers carelessly discarding burning embers). The mitigation measures are prevention oriented through vegetation management (regular mowing and brushing) as per Section 6.1.6 of the EPP to reduce the risk of fires from vehicles parked on the vegetation along the proposed RoW.

Based on stakeholder consultation with the CVFPMB, study team observations, it is apparent that incremental timber harvesting is occurring as a result of perceived economic benefit by property owners in anticipation of the RoW. Incremental harvesting is difficult to quantify at this time, as it is in-progress.



There is anecdotal evidence of landowners reacting to finding survey lines across their property and assuming the location is established and reacting to it by harvesting immediately, only to have the alignment moved in the evaluation process.

In consultation with the CVFPMB, a review of available information was conducted in an attempt to confirm the occurrence. Using NB Transportation Certificate data between April 2002 and August 7th, 2003, delivery records for properties intersecting the proposed RoW were extracted and a field sample conducted.

Of 478 properties that intersect the proposed RoW, 36 (7.5%) reported wood volumes delivered to processing plants during the sample period. Twelve were field visited and 10 had harvesting beyond the RoW. The volumes reported ranged from 38.5 m³ to 3,080 m³, with an average volume harvested per property of 609 m³.

NBDOT will inform landowners well in advance of the expropriation process to avoid triggering incremental harvesting arising from uninformed speculation.

Agricultural Land Use

During all of the Project activities there is a risk of accidents, malfunctions and unplanned events.

During all Project activities there is a risk of spring grass fires being started from either the highway construction workers or highway users. The greatest risk of fire is during site preparation and subsequent construction activities during the early spring. The primary mitigation of accidental fires is through prevention as per Section 4.0 of the EPP. The EPP suggests a preference for conducting forest clearing during the winter months during which time fire hazards are reduced and includes obtaining a burning permit from NBDNR.

During all operations, fire protection equipment requirements must be consistent with those required on all forest operations in New Brunswick as specified within the *Forest Fires Act* and the EPP (Section 7.4 Forest Resources). In all construction activities, NBDOT inspectors should monitor clearing and other relevant operations to ensure equipment is functional and personnel are trained in its usage with respect to forest fire prevention.

During the operation of the proposed TCH the risk of fire is related to weather, roadside vegetation management and human error (cars parking in the grass or smokers carelessly discarding burning embers). The mitigation measures are prevention oriented through vegetation management (regular mowing and brushing) as per Section 6.1.6 of the EPP to reduce the risk of fires from vehicles parked on the vegetation along the proposed RoW.



Summary - Accidents, Malfunctions and Unplanned Events

The potential environmental effects of accidents, malfunctions and unplanned events based on planned mitigation, considered not significant.

5.8.5.3 Determination of Significance

Table 5.8.10 presents a summary of the residual environmental effects of the Project on land uses.

Table 5.8.10 Residual Environmental Effects Summary Matrix for Land Use

Residual Environmental Effects Summary Matrix Valued Environmental Component: LABOUR AND ECONOMY				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	3	3
Operation	NS	3	3	3
Maintenance	NS	3	1	1
Accidents, Malfunctions and Unplanned Events	NS	3	1	1
Project Overall	NS	3	2	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

The residual environmental effects of the Project on Land Use are in consideration of planned mitigation and the residual environmental effects rating criteria, are considered not significant.

5.8.6 Monitoring and Follow-up

No significant environmental effects were identified. However, monitoring may be required if potential environmental effects are identified (e.g., noise-related complaints). This would likely entail traffic counting and noise monitoring as discussed further in Section 5.1.6 (Atmospheric Environment VEC).

A further consideration for monitoring and follow-up would be to confirm that the established recreational trails maintain continuity across the RoW.





5.9 Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

5.9.1 Rationale for Selection as Valued Environmental Component

For the purposes of this assessment, Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons is defined as the use of lands, and resources within those lands, that are within the footprint of the Project or on adjacent lands where those uses and resources are potentially affected by the Project. This "use" refers to contemporary hunting, fishing, and gathering activities for subsistence purposes as well as the use of lands and resources for social and ceremonial activities.

The proposed Project will result in the loss of terrestrial habitat as a result of Construction. During Operation, land or surface water adjacent to the Project facilities may be affected (e.g., by the use of road salt). Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons was selected as a VEC to assess the potential interactions between Project activities and any current uses of the lands and resources that may potentially be affected by Project activities.

5.9.2 Environmental Assessment Boundaries

5.9.2.1 Spatial and Temporal

The spatial boundaries for the Project include the RoW boundaries where activities associated with construction, operation, and malfunctions and accidents of the Project could result in environmental effects on the terrestrial or aquatic environments. For the purposes of this assessment, any current use of land and resources within the limits of clearing for the highway is assumed to be permanently removed.

The temporal boundaries of the Project include the construction period, and operation and maintenance in perpetuity.

5.9.2.2 Administrative and Technical Boundaries

The Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons can best be determined by the Aboriginal Community. To that end, NBDOT has funded a Traditional Ecological Knowledge (TEK) study that was undertaken by the Tobique Economic Development Corporation (TEDCO) on behalf of the Chiefs of the six Maliseet First Nations communities in New Brunswick (Oromocto, St. Mary's, Kingsclear, Woodstock, Tobique, and Madawaska). The report resulting from this study, while completed, has not been made available to NBDOT to date. Representatives of TEDCO have provided a brief summary of issues raised (C. Cameron, pers. comm.). In addition, staff from NBDOT and their environmental consultants attended and participated in a series of six open



houses conducted by TEDCO, where information was gathered from those attending the sessions held in each of the communities. Finally, there has been correspondence and communication between NBDOT and some of the elected Chiefs of the six Maliseet communities. This environmental assessment relies upon the information gathered from those sources. It should be noted that no specific hunting, fishing or gathering areas have been identified within the Project boundary, from these sources. Similarly, no specific ceremonial or spiritual sites have been noted in the Project area in the information provided, and nothing specific has been mentioned to NBDOT staff or their consultants during the open house sessions or at any other time during this process. Information gathered during the TEK Study (TEDCO 2003) for the Pokiok to Longs Creek four-lane highway section was, where appropriate, also included in this assessment. The Pokiok to Longs Creek highway is part of the same Route 2 highway and is located approximately 40 kilometres from this Project.

The proposed study methodology was the same as that used by TEDCO in the previous TEK study (TEDCO 2003) for the construction of the Pokiok to Longs Creek four-lane section of the Trans-Canada Highway. The process began with the hiring of Maliseet members of each of the six communities. These individuals were referred to as the community coordinators. Their primary role was to gather information, conduct research and interviews of various community members, community elders, traditionalists, and resources users (e.g., hunters, fishers, and gatherers). Site visits were also conducted in areas where the study identified a need for additional data. It widely accepted that a trusting relationship between the interviewer and the interviewee is essential to ensure that the information is provided in an open and honest manner. Frequently, individuals within a First Nation community will provide more information to someone they know, which increases the quality of the TEK study. These coordinators were also responsible for organizing and attending the open houses in each of the communities. These Open houses provided a forum to launch the consultation and TEK study processes. Members of NBDOT staff and their consultants, as well as the community coordinator and staff from Aboriginal Resource Consultants (the consulting firm hired by TEDCO to oversee the TEK and community consultation) were all present at each of the six open houses. This presence allowed for those attending the open house to ask questions on the design and proposed location of the highway, the information resulting from the field studies, and raise any questions about the TEK and consultation process with those directly responsible. In addition, any comments provided during these forums were noted by the participants for incorporation in the overall assessment of the environmental effects from the Project.

In addition, previous relevant environmental assessments (from other highway projects), drafts of the Project CSR and Screening Report, and Project field study reports were presented to the coordinators. These documents were left within the community and were housed at a location where anyone within the community could review them and provide further comment. Mapping of all the Project areas was provided showing the information that had been gathered as a result of the field studies. These maps



were also left with the coordinators with the same community access provision as the other documentation.

The community coordinators were provided instruction on the draft versions of the various environmental assessments regarding where to find relevant information that community members might seek and how the assessment of potential environmental effects on other VECs was undertaken. The coordinators were also instructed as to the use of the numerous maps that were provided to each community. Contact information for NBDOT as well as their environmental consultants was also provided, should any member of the community wish to speak directly to those individuals or if the community coordinators had questions.

The role of the community coordinators was to function as conduits for information and questions about the Project to and from their respective communities, and to generate the information for the TEK study.

The methodology for the TEK study followed an eight-step process.

- Engage local community coordinators (discussed above).
- Define the objective of the study –to gather relevant data from knowledgeable community sources and attempt to determine whether the proposed construction activities could potentially have a negative effect on any areas of significance.
- Develop a list of informants – identify a list (which could be amended at any time to add more people) of elders, hunter/fishers, ceremonial/traditional users who are recognized as possessing the information.
- Develop a questionnaire – to ensure that a structured and consistent approach was followed during the discussion process, a questionnaire was developed and used as a guide by the coordinators.
- Mapping – provided by NBDOT and their consultants to assist the interview process.
- Contact Interviewees – various members of each community were contacted to participate in the TEK study. The purpose and objectives of the study were explained to each person interviewed and a convenient meeting time arranged. Notes were either taken during the interview or written afterwards, depending upon the preference of the interviewee.
- Report – the information gathered for the TEK study was consolidated into a detailed report.



- Site visit – when requested or warranted, a site visit was undertaken in order to assist in the understanding of the project and presentation of information.

Finally, it must be noted that information is sometimes provided with the condition that it not be made public due to the potential for exploitation.

5.9.3 Criteria for Establishing Threshold of Significance

A *significant residual environmental effect* is an unmitigated long-term Project-induced change in the current use of land and resources for traditional purposes by Aboriginal people or First Nation communities. If it was determined that adverse changes to the access to, or the availability of, such land and resources to members of the local First Nation communities was the result of the Project, this was considered an adverse environmental effect.

5.9.4 Existing Conditions

The proposed four-lane highway route primarily travels through rural settings that are either forested or currently being used, or has in the relatively recent past been used, for agriculture. There is virtually no Crown Land being traversed by the highway routing. Almost all of the forested areas within the RoW have been previously harvested at some point in the past, ranging in time from recently to 100 years or more.

The summary information of the TEK study indicated that a large percentage of those interviewed expressed a concern that the construction of the Project could adversely affect the availability of various game animals located along the proposed highway route, in areas considered traditional Maliseet territory. The summary suggested that the depletion of these resources would eliminate Traditional Aboriginal use of the area.

The summary also indicated that some interviewees indicated that there were locations within the Meductic and Flat Top Mountain areas that have been used by the Maliseet People in the past for ceremonial and spiritual purposes.

The summary also indicated that there were concerns regarding how the Maliseet community would be assured they had an opportunity to review potential environmental effects to such things as burial grounds or gathering locations and/or lands of spiritual significance, if there is no direct Maliseet involvement in the ongoing monitoring of the Project.

Although not explicitly cited in the summary information provided to NBDOT, it is assumed, due to the proximity of this Project with other highway projects for which a similar TEK study was undertaken, a



general concern over other issues will be expressed for this Project. These could include such issues as: the availability of black and white ash trees in the area (TEDCO 2003), the collection of cedar, sweet grass, white birch fungus, and other traditional medicinal plants, the Maliseet trail, the condition of rivers, lakes and brooks and their use as guiding tools for travelling, and the potential for finding previously unknown burial grounds.

5.9.5 Environmental Effects Analysis

5.9.5.1 Project-VEC Interactions

This section evaluates the significance of potential residual environmental effects resulting from Project interactions with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VEC. The assessment of environmental effects includes mitigation. Although no specific locations within the zone of influence of the Project or along the proposed highway route have been identified, the information available indicates a number of current issues regarding land and resources used for traditional purposes by Aboriginal purposes that may be affected by the Project. A summary of the potential environmental effects resulting from Project-VEC interactions is provided in Table 5.9.1. This table includes accidents, malfunctions, and unplanned events.

Table 5.9.1 Project Activity – Environmental Effects Interaction Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Potential Interactions Between Project Activities, Including Other Projects, and Environmental Effects Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>	
Project Activities and Physical Works	Potential Environmental Effect Project Related Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons
Construction	
Site Preparation	✓
Roadbed Preparation	
Surfacing and Finishing	
Watercourse Crossing Structures	✓
Ancillary Structures and Facilities Construction	✓
Operation	
Winter Safety	✓
Proposed TCH Presence	✓
Maintenance	
Proposed TCH Maintenance	
Vegetation and Wildlife Management	
Accidents, Malfunctions and Unplanned Events	
Construction	✓
Operation	✓
Maintenance	✓



Table 5.9.1 illustrates that the initial phases of construction activities as well as the presence of the highway itself have the potential for interaction with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VEC.

5.9.5.1.1 Construction

The construction process associated with the highway project involves various groundbreaking activities that will result in the loss of terrestrial habitat. However, as noted in Section 2 of this document, the routing of this highway has been selected to avoid to the extent possible, areas identified as critical habitat, such as wetlands. Construction activities will include permanent crossings of all watercourses along the route. This activity has the potential to result in adverse environmental effects on fish and fish habitat as well as water quality in these watercourses. Although a concern was expressed in the Pokiok to Longs Creek TEK Study (TEDCO 2003) over potential Project environmental effects to lakes and ponds, no such waterbodies will be crossed by the proposed highway route. There is the potential for construction to affect ceremonial sites located along the proposed highway. All tree species within the RoW area defined for clearing will be cut down including all black and white ash, cedar, and birch trees. The construction of ancillary facilities such as borrow areas / gravel pits may result in adverse environmental effects on land and resources relevant to this VEC in those areas. The activities associated with the later phases of Construction of the Project, such as the surfacing and finishing of the highway, are not anticipated to interact with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VEC

5.9.5.1.2 Operation

Winter safety activities, such as the application of salt may interact with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, in such areas as water quality on adjacent watercourses in regards to overall fish health and availability. The presence of the highway itself will remove various plant species from the immediate highway RoW and displace from the immediate highway RoW a variety animal species that may affect the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VEC.

5.9.5.1.3 Maintenance

Within the normal activities associated with highway maintenance, there will be no substantive interaction between this phase of the Project and the VEC.



5.9.5.1.4 Accidents, Malfunctions and Unplanned Events

During Construction, Operation and Maintenance, there is the potential for interaction between the Project and the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons in the case of Accidents, Malfunctions or Unplanned Events. The accidental release of a contaminant (*i.e.*, a spill) has the potential to have an adverse environmental effect on the VEC.

5.9.5.2 Environmental Effects Analysis and Mitigation

The following tables in this section provide the residual environmental effects assessment matrices for Project activities that could potentially interact with the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons. The section has been divided into Project phases (*i.e.*, Construction, Operation, Accidents, Malfunctions and Unplanned Events). The text following each table provides a discussion of the environmental effects and mitigation outlined in the matrix.

5.9.5.2.1 Construction

Table 5.9.2 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>							
Phase: <u>Construction</u>							
Project Activity	Potential Adverse Environmental Effect,	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	- Implement Black and White Ash Harvesting plan - Fish and Fish Habitat, Vegetation, Wetlands, and Wildlife, and Archaeological Resources Mitigation as described in Sections 5.4, 5.5, 5.6, 5.7, and 5.10	1	3	3/6	R	2
Watercourse Crossing Structures	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	Fish and Fish Habitat, Vegetation, Wetlands, and Wildlife, and Archaeological Resources Mitigation as described in Sections 5.4, 5.5, 5.6, 5.7, and 5.10	1	1	3/2	R	2



Table 5.9.2 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>							
Phase: <u>Construction</u>							
Project Activity	Potential Adverse Environmental Effect,	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Ancillary Structures and Facilities Construction	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	Conduct rare plant and archaeological survey prior to groundbreaking in these areas if they are a new development	1	1	3/1	R	2

KEY

Magnitude:

1 = Low: e.g., short-term change in Aboriginal land use and access to resources, localized

2 = Medium: e.g., short to medium-term change in Aboriginal land use and access to resources and may extend to the areas adjacent to the Project footprint.

3 = High: e.g., long-term change in Aboriginal land use and access to resources and may extend well outside the Project Footprint

Geographic Extent:

1 = <10 ha (0.1 km²)

2 = 0.1-1 km²

3 = 1-10 km²

4 = 11-100 km²

5 = 101-1000 km²

6 = >1000 km²

Frequency:

1 = < 11 events/year

2 = 11-50 events/year

3 = 51-100 events/year

4 = 101-200 events/year

5 = >200 events/year

6 = continuous

Reversibility:

R = Reversible

I = Irreversible

Ecological Socio-cultural and Economic Context:

1 = Relatively pristine area or area not adversely affected by human activity.

2 = Evidence of adverse environmental effects.

NA = Not Applicable

(A) = adverse

(P) = positive

Construction activities associated with the Project will result in the loss of terrestrial habitat due to the footprint required. However, as described in Section 2, the alignment of the RoW has been selected to avoid critical vegetation and wildlife habitat, including wetlands. Adverse environmental effects resulting from the Project related to the hunting and gathering of various wildlife species (e.g., moose, deer, and partridge) are discussed in detail in Section 5.7 of this EA and are considered not significant. Although some habitat for moose, deer and partridge will be lost, these species will not be significantly affected. A range of mitigation measures have been proposed in Section 5.7 to minimize the potential environmental effects on wildlife. Therefore, since the population of these species is not anticipated to be significantly affected, it is unlikely that the ability to hunt these species will be significantly affected by the Project. In addition to this, although the Aboriginal community has indicated that they do hunt some of these species, in particular moose, in the area of the proposed RoW, no specific locations of concern have been identified to NBDOT.



Adverse environmental effects resulting from the Project on the plant species within and along the RoW are discussed in detail in Section 5.5 of this EA and are considered not significant. Species such as sweet grass, mentioned in the previous TEK study, was not identified along the RoW during the plant surveys. For the rare plants identified along the RoW, numerous adjustments to the RoW have been implemented to avoid these resources. While it is possible that some traditionally gathered plants do exist within the RoW and thus may be lost during construction activities, mitigation for any known rare species has already been implemented. Other species must therefore be relatively common, and therefore can still be gathered in adjacent or nearby areas.

Construction activities in and around watercourses will result in the alteration, destruction or disruption of fish and fish habitat. However this effect will be temporary and minimal in extent, and will be fully compensated. Only the portion of the watercourse required to be crossed by the highway will be directly affected. The remaining portion of each watercourse will be unaffected by the Project. Adverse environmental effects on fish and fish habitat resulting from the Project are discussed in detail in Section 5.4 of this document and are not considered significant. A range of mitigation options for the effects on fish and fish habitat is also discussed in detail in Section 5.4. Similarly, all navigable watercourses include mitigation to ensure navigability is maintained. As such, it is expected that current use of these waterways as guiding tools will not be adversely affected by the Project.

As previously stated in this document, the location of ancillary facilities (e.g., borrow pits), which could have adverse environmental effects on VECs identified in this report, cannot be determined at this time. For this Project, such facilities are not permitted to be located in environmentally sensitive areas such as wetlands, thereby protecting those resources. In addition, NBDOT has committed to subjecting these locations (once identified) to an environmental survey that will include a rare plant survey and an archaeological resources survey.

To mitigate potential concerns about black and white ash, NBDOT has stated that it will develop and implement, if desired, a similar Black and White Ash Harvesting Plan as it did for the Pokiok to Longs Creek highway section, in consultation with the Maliseet First Nations. This plan included the marking of specific tree species (in this case Ash) prior to clearing by professional foresters and members of the Maliseet community. During clearing these species were set aside and piled separately for pick-up and trucking to the Maliseet communities to be used in various cultural activities, such as basket making.

Cedar and white birch are widely available in the region and no specific mitigation is recommended for these species. Species mentioned in the previous TEK study (TEDCO 2003) such as fiddleheads and sweet grass were not specifically mentioned in the summary information provided for this Project. Fiddleheads (*Matteuccia struthiopteris* or ostrich fern) were reported during the vascular plant surveys for this Project, however specific locations where this species was found are unavailable. Sweet grass (*Hierochloë odorata*), however, was not recorded. While it is possible that sweet grass exists within the



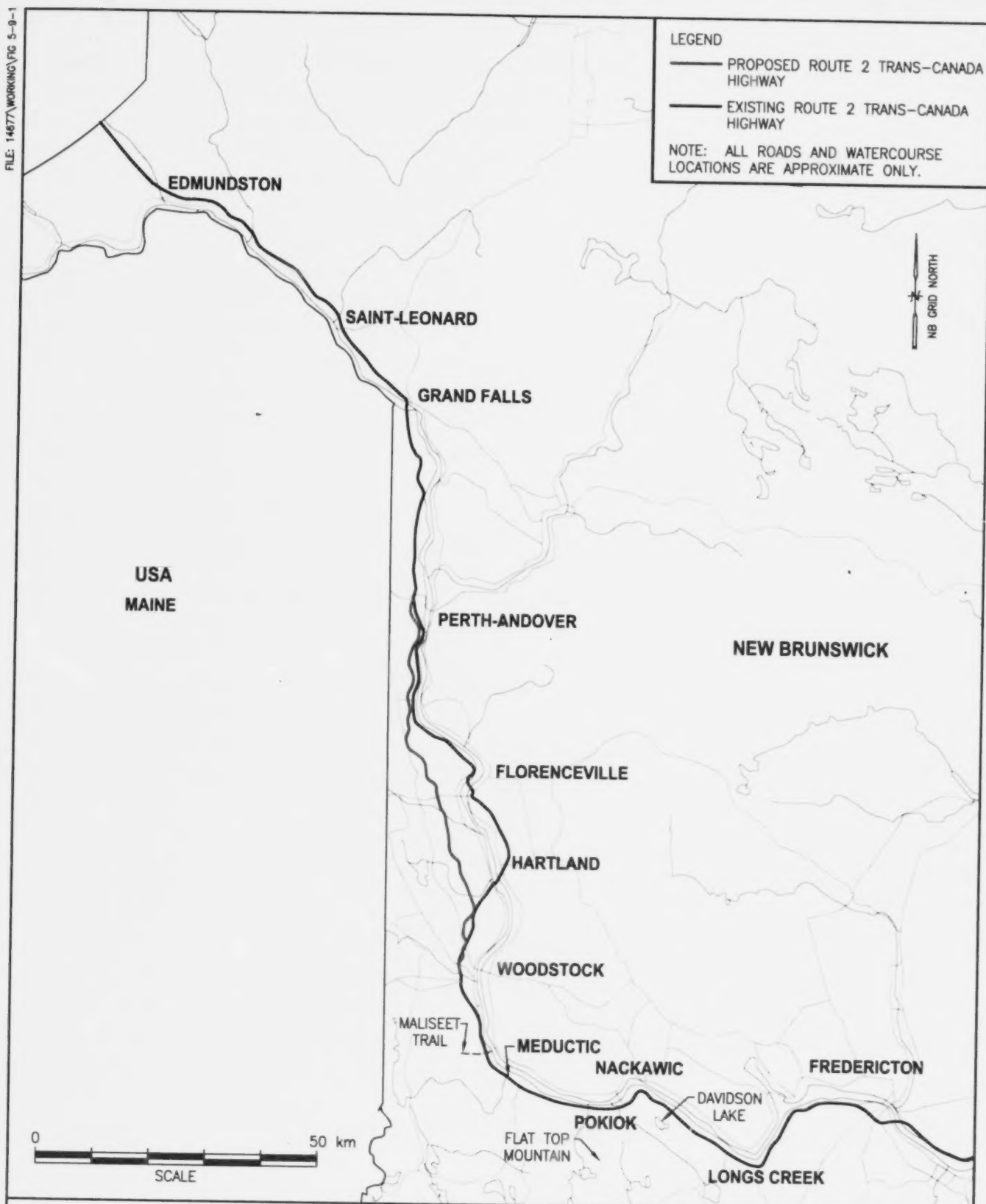
proposed RoW, field personnel would likely have recorded this species if it had occurred in the study area in large patches. Adverse environmental effects on wetlands resulting from the Project are discussed in detail in Section 5.6 of this document and are not considered significant. A range of mitigation options for the environmental effects to wetlands are also discussed in detail in Section 5.6. Since the populations of these species are not anticipated to be significantly affected by the Project, it is unlikely that the ability to gather these species will be significantly affected by the Project. In addition to this, no specific gathering locations were identified within the RoW.

During the TEK study and the open houses, it was indicated that there are locations within the Meductic (Maliseet Trail) and Flat Top Mountain areas that have been used by the Maliseet People in the past for ceremonial and spiritual purposes. Davidson Lake, in the Pokiok to Longs Creek area, was also mentioned in this context. As can be seen in Figure 5.9.1, these locations are a considerable distance from the proposed highway route for this Project. Therefore, due to the distance from the Project to these locations (ranging from 15 to 40 or more kilometres) and the fact that there has been no identified interaction between these areas and the Project, any potential environmental effects to these areas as a result of the Project are considered not significant.

As noted in Section 5.10, a professional archaeologist has reviewed the potential for the loss of archaeological and heritage resources in the Project area. Although two individual artifacts were recovered on the banks of two separate watercourses (Section 5.10), there were no habitation features associated with these artifacts and the Project will not result in the loss of any of these resources. Section 5.10 outlines mitigation that ensures that any resources found during construction will be protected through implementation of contingency measures that will include contact and involvement of the Maliseet First Nations.

To address the concerns presented in the TEK summary information regarding how the Maliseet community will have an opportunity to review potential environmental effects of the project, a number of initiatives have and will take place. First, as mentioned above, each of the six communities have access to the environmental assessment reports for the sections of the highway near their communities. In addition, the First Nations consulting company, Aboriginal Resources Consultants (ARC), hired to oversee the community consultation process, was provided with copies of the original background study reports upon which the assessments were based. As also mentioned, NBDOT paid, through ARC, for the hiring of the community coordinators who were to be a conduit for information between their respective communities and NBDOT and its consultants. At all of the open houses Project and contact information was made available and all who attended these sessions were encouraged to take this information with them at the end of the session. These handouts contained contact names, addresses and telephone numbers in case any additional information was sought, questions were forthcoming or if anyone wanted to provide further relevant information. Copies of these handouts were left with the community coordinators as well. A questionnaire was also provided at the open house sessions.





APPROXIMATE LOCATION OF
FEATURES MENTIONED DURING
TEK STUDY

Date:
2004 05 17

Scale:
AS SHOWN

Job No.:
14677

Fig. No.:
5.9.1



Jacques Whitford

Consulting Engineers
Environmental Scientists

THIS DRAWING IS THE PROPERTY OF JACQUES WHITFORD AND IT SHALL NOT BE
GIVEN OUT, COPIED OR REPRODUCED FOR THE USE OF ANOTHER BUT SHALL BE
USED ONLY BY THE RECIPIENT FOR THE PURPOSE TO WHICH IT RELATES.

It asked such questions as “Did you feel that the information presented to you today was helpful?”, “Do you know of any current use of the area of the proposed four-lane highway?”, and “What are your main areas of interest or concern on which we should focus our project design...?”. Space was also provided for any other comments and the person’s name, which was optional. Copies of this questionnaire were also left with the community coordinator.

NBDOT intends to continue in its open communication with the six communities. NBDOT has offered to establish a Maliseet Nation Liaison Committee composed of an individual from each community and one full time Aboriginal Coordinator, who will be part of the highway project team. The proposal is that the six community representatives will meet with the Aboriginal Coordinator a minimum of four times per year, perhaps monthly initially, during the construction of the Project in order to discuss issues related to the construction of the highway. Visits to the RoW could be arranged during construction (for safety reasons, members of the public are not encouraged to visit the RoW unaccompanied by Project personnel). NBDOT has offered to pay for the participant’s time and cover any expenses related to this Liaison Committee.

5.9.5.3 Operation

Table 5.9.3 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix							
Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>							
Phase : <u>Operation</u>							
Project Activity	Potential Adverse Environmental Effects	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Winter Safety	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	Surface water mitigation described in section 5.3	1	2	2/2	R	2
Proposed TCH Presence	Change in Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	Fish and Fish Habitat, Vegetation, Wetlands, and Wildlife, and Archaeological Resources Mitigation as described in Sections 5.4, 5.5, 5.6, 5.7, and 5.10	2	3	5/6	I	2



Table 5.9.3 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix					
Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>					
Phase : <u>Operation</u>					
Project Activity	Potential Adverse Environmental Effects	Mitigation	Evaluation Criteria for Assessing Environmental Effects		
			Magnitude	Geographic Extent	Duration/Frequency
					Reversibility
					Ecological/Socio-Cultural and Economic Context
KEY Magnitude: 1 = Low: e.g., short-term change in Aboriginal land use and access to resources, localized 2 = Medium: e.g., short to medium-term change in Aboriginal land use and access to resources and may extend to the areas adjacent to the Project footprint. 3 = High: e.g., long-term change in Aboriginal land use and access to resources and may extend well outside the Project Footprint Geographic Extent: 1 = < 10 ha (0.1 km ²) 2 = 0.1-1 km ² 3 = 1-10 km ² 4 = 11-100 km ² 5 = 101-1000 km ² 6 = >1000 km ² Frequency: 1 = < 11 events year 2 = 11-50 events year 3 = 51-100 events year 4 = 101-200 events year 5 = >200 events year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive					

Winter weather requires that, in the interests of safety, all public roads be salted in order that the driving surface is kept free of snow and ice. Adverse environmental effects resulting from the Project relating to the quality of surface water as a result of road salt are discussed in detail in Section 5.3 and are considered not significant. A range of mitigation measures has been proposed in Section 5.3 to minimize the potential environmental effects on Surface Water.

The presence of the highway will obviously prevent any Current Land and Resource Use for Traditional Purposes by Aboriginal Persons within the RoW. However, it is anticipated that activities, such as hunting, fishing and gathering, will simply be displaced to areas immediately adjacent to the proposed RoW. In the case of fishing, for example, this activity can easily be accommodated either up or down stream of the RoW and in the case of large bridge structures, accommodated under the bridge following the completion of construction activities. No adverse environmental effects to any animal, bird or plant populations are anticipated as a result of this Project with the implementation of the mitigation measures discussed in Section 5.4, 5.5, 5.6, and 5.7. The only potential environmental effect on Wildlife as a result of the presence of the highway will be on their movement across the area, which in some locations will be blocked by the highway. This issue will be addressed by the installation of wildlife fencing and



the provision of wildlife crossing structures at various locations along the highway (these locations will be determined in conjunction with NBDNR). No traditional habitation sites were identified within the RoW during the archaeological resources survey of the RoW. Mitigation measures to address any concerns should an unknown pre-contact archaeological site be encountered during construction are discussed in Section 5.10. Adverse environmental effects from the Project relating to the presence of the highway are considered not significant.

5.9.6 Accidents, Malfunctions and Unplanned Events

Table 5.9.4 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix Valued Environmental Component: CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity	Potential Adverse Environmental Effects	Mitigation	Evaluation Criteria for Assessing Environmental Effects				
			Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Construction	Change in Current use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	- Fish and Fish Habitat, Wetland, and Archaeological and Heritage Resources Mitigation as described in Sections 5.4, 5.6 and 5.10 - Surface Water mitigation described in section 5.3	1	1	1/1	R	2
Operation	Change in Current use of Land and Resources for Traditional Purposes by Aboriginal Persons (A)	- Fish and Fish Habitat, Wetland, and Archaeological and Heritage Resources Mitigation as described in Sections 5.4, 5.6 and 5.10 - Surface Water mitigation described in section 5.3	1	1	1/1	R	2



Table 5.9.4 Environmental Effects Assessment Matrix for Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

Environmental Effects Assessment Matrix					
Valued Environmental Component: CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS					
Phase: Accidents, Malfunctions and Unplanned Events					
Project Activity	Potential Adverse Environmental Effects	Mitigation	Evaluation Criteria for Assessing Environmental Effects		
			Magnitude	Geographic Extent	Duration/Frequency
					Reversibility
					Ecological/Socio-Cultural and Economic Context
KEY Magnitude: 1 = Low: e.g., short-term change in Aboriginal land use and access to resources, localized 2 = Medium: e.g., short to medium-term change in Aboriginal land use and access to resources and may extend to the areas adjacent to the Project footprint. 3 = High: e.g., long-term change in Aboriginal land use and access to resources and may extend well outside the Project Footprint Geographic Extent: 1 = <10 ha (0.1 km ²) 2 = 0.1-1 km ² 3 = 1-10 km ² 4 = 11-100 km ² 5 = 101-1000 km ² 6 = >1000 km ² Frequency: 1 = <11 events/year 2 = 11-50 events/year 3 = 51-100 events/year 4 = 101-200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive					

The type of accident envisioned that could have an adverse environmental effect on this VEC is the spill of a contaminant or a toxic substance into a wetland or watercourse. While a major spill in one of these areas could have significant adverse environmental effects, an accident of this nature is considered unlikely. Adverse environmental effects on Surface Water, Fish and Fish Habitat, Wetlands, and Archaeological and Heritage Resources resulting from an accident, malfunction or unplanned event during the Project are discussed in detail in Sections 5.3, 5.4, 5.6, and 5.10 of this document and are not considered significant. A range of mitigation options for the environmental effects to Surface Water, Fish and Fish Habitat, Wetlands, and Archaeological and Heritage Resources are discussed in detail in Section 5.3, 5.4, 5.6 and 5.10.

5.9.6.1 Determination of Significance

Table 5.9.5 evaluates the significance of potential residual environmental effects resulting from the interaction between Project activities and Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, after taking into account any proposed mitigation. The table also considers the level of confidence of the study team in this determination and the likelihood of potential environmental

effects. The residual environmental effects are considered not significant for all Project phases. A potentially major hazardous material spill for the Project would be considered a significant accident however, is viewed as unlikely to occur. It is anticipated that NBDOT's willingness to continued communication with the Aboriginal communities would provide an opportunity to manage and mitigate potential adverse environmental effects that are identified in respect of the Project.

Based on this analysis, the residual environmental effects of the Project on the Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons VEC are rated as not significant, with the exception of Accidents, Malfunctions, and Unplanned Events that are related to fish and fish habitat. Although it is possible for an accident to occur that could damage fish habitat, or result in fish mortality, the likelihood of an event with a magnitude great enough to result in a significant residual adverse environmental effect is considered very low.

Table 5.9.5 Residual Environmental Effects Summary Matrix for Current use of Land and Resources for Traditional Purposes by Aboriginal Persons

Residual Environmental Effects Summary Matrix				
Valued Environmental Component: <u>CURRENT USE OF LAND AND RESOURCES FOR TRADITIONAL PURPOSES BY ABORIGINAL PERSONS</u>				
Phase	Residual Environmental Effects Rating*	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	1	2
Operation	NS	3	1	2
Maintenance	N/A	N/A	N/A	N/A
Accidents, Malfunctions and Unplanned Events	S	3	1	3
Project Overall	NS	3	1	2
Key: Residual environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

5.9.7 Monitoring and Follow-up

In order to keep the lines of communication open between NBDOT and the Maliseet First Nation communities it is recommended that, in consultation with the six Maliseet Chiefs, the Maliseet Nation Liaison Committee be established and that NBDOT create and fill the position of the Aboriginal Coordinator. This effort can only accomplished if there is the desire and cooperation of the six Maliseet



communities. While NBDOT will be the catalyst for this effort, the ability for it to function properly and provide meaningful information to the communities must come from within the communities and their Chiefs.

NBDOT is committed to ongoing monitoring and, where practical, mitigation of issues raised and potential adverse environmental effects as a result of the Project on the current use of land and resources for traditional purposes that are identified by the Aboriginal Community throughout the construction of the Project.



5.10 Archaeological and Heritage Resources

5.10.1 Rationale for Selection as Valued Environmental Component

For the purposes of this assessment, archaeological and heritage resources are defined as any physical remnants found on top of and/or below the surface of the ground that inform us of past human use of and interaction with the physical environment. These resources may be from the earliest prehistoric times of human occupation within the proposed RoW, up to the relatively recent past and include both build and depositional resources. Although more related to issues of evolution or biophysical "heritage", palaeontological resources or fossil bearing rocks are also included within this VEC.

Archaeological and heritage resources are included as a VEC in this assessment in recognition of the interest of potentially affected First Nations, the general public as a whole, and provincial and federal regulatory agencies assuring the effective management of these resources. In this section, the environmental effects of the Project activities on archaeological and heritage resources resulting from construction and operation activities, as well as malfunctions, accidents or unplanned events, will be assessed.

5.10.2 Environmental Assessment Boundaries

5.10.2.1 Spatial and Temporal

The spatial boundaries for the Project include the locations of all Project related activities associated with construction, operation, and malfunctions and accidents that could involve any ground disturbance. Archaeological and heritage resources may be affected by any surficial or subsurface project-related disturbance of the area within which these resources are located. The assessment of potential Project related environmental effects on archaeological and heritage resources is focused principally on those Project activities (including related geotechnical investigations) that entail ground disturbance, and within the physical limits of those activities.

The temporal boundaries include the construction periods and operation of the Project in perpetuity. Archaeological and heritage resources are relatively permanent features of the environment, however their integrity is highly susceptible to the environmental effects of any ground disturbing activities. Construction activities carried out at any time of year can therefore affect the integrity of any archaeological or heritage site encountered. It should be noted, however, that archaeological fieldwork to mitigate potential adverse environmental effects on heritage resources is more easily carried out between late spring and early autumn, when ground conditions allow for the subsurface testing required in archaeological investigations.



Ground disturbance associated with construction will be relatively short-term. However, any potential adverse environmental effect on archaeological and heritage resources will be permanent, as no archaeological site can be returned to the ground in its original state.

5.10.2.2 Administrative and Technical Boundaries

Archaeological resources in the province of New Brunswick are administered by Archaeological Services Unit (ASU), within the Heritage Branch, of the Culture and Sports Secretariat. Archaeological sites are considered to be a non-renewable resource and the unauthorized disturbance of such resources may not legally take place except under strictly controlled conditions imposed by terms of an Archaeological Field Research License which is issued to qualified personnel by the provincial government through ASU. ASU is also responsible for approving or modifying recommended mitigation measures. Some archaeological sites can be assigned a "protected" status under the *Historic Sites Protection Act* if so designated by the Minister. The unauthorized disturbance of a protected heritage resource is punishable by a fine. Built heritage resources (*i.e.*, architectural resources) are administered by the Planning and Commencerative Unit, Heritage Branch, Culture and Sports Secretariat. The inventory of palaeontological resources is maintained by the New Brunswick Museum.

Baseline information for this assessment included the Maritime Archaeological Resource Inventory files located at ASU in Fredericton, the inventory of historic buildings, the list of Provincially Designated Historic Sites, research at the Public Archives of New Brunswick, local historical records, documented local histories, local informants, three baseline studies on heritage resources within the RoW, and the knowledge of the various consultant archaeologists involved with the three baseline studies. Limitations imposed on this assessment include the inability to accurately and completely predict the presence of all existing archaeological sites. It is not possible to predict for such features as animal kill sites or isolated burial sites based on the randomness of their locations and/or unknown patterns of distribution.

The EA of the Archaeological and Heritage Resources does have technical boundaries. These pertain mainly to the methodology of field testing implementation and the determination of high potential. The models for determining archaeological potential are designed, based on the professional judgement and experience of the archaeologist and the general knowledge of the archaeological community in the Maritimes. The testing strategies are determined in consultation with the regulatory authority, Archaeological Services Unit, and the professional archaeologist applying for the license to conduct any required field work, in combination with the state of the available data on the location and configuration of known archaeological sites within the general area of the Project. Spacing for the excavation of testpits is based on the nature of the sites sought in the investigation and the interpreted archaeological potential of the area under investigation. Recent Guidelines (New Brunswick Culture and Sport Secretariat, Heritage Branch 2004) provided by the Province suggest a testing interval of 5 to 10 metres depending upon the potential for encountering archaeological sites. The higher the potential the closer



the testing interval. Testpits were 50 cm by 50 cm squares excavated to the glacial till, which is the typical terminus for any potential for cultural material. All soils from the testpits were sieved through 6 mm mesh screens (standard archaeological size) to ensure no cultural material was missed. The determination of archaeological potential is somewhat less universally accepted, however. The reason for this is that, particularly in the Maritimes, so few archaeological sites have been excavated relative to the number of sites that must have existed prior to the arrival of European settlers. Therefore, the interpretation of which areas were desirable for habitation is weighted by the sites that have been discovered. Typically, these sites are in easily accessible areas, and areas that to modern archaeologists seem like reasonable areas for people to have settled, such as along the edges of river, lakes, and coastal areas.

Although archaeological sites have been discovered in what would be characterized as "unusual" areas (areas considered "in the middle of no-where"), archaeologists have yet to determine why people would have used these areas, and therefore no models exist that could predict for the presence of such sites. The location of such sites may be somewhat explained as palaeo-environmental reconstruction's become more accurate and geologists and archaeologists have a better understanding of the location of old river channels and other desirable topographical features. Only since 1987 has New Brunswick's *Environmental Impact Assessment Regulation 87-83* of the *Clean Environment Act* required proponents, where appropriate, to consider archaeological and heritage issues during any environmental assessment of their project, thus giving archaeologists the potential to investigate previously inaccessible areas, and have the funding to support this research. To date, archaeological research has tended to reinforce previous attitudes about what constitutes a "high potential" archaeological area, and thus professionals can only base their predictions on the knowledge at hand.

For this Project, 5 m to 10 m intervals were established as the standard for field-testing in areas of elevated potential. With respect to archaeological potential, availability of potable water, suitability for habitation (e.g., ground conditions), proximity to desirable resources (such as workable stone), and proximity to water transportation routes, portage routes and food supplies were used as determining factors. In addition to testpitting (or testing) various other methods were used to examine the subsurface soils along the proposed alignment. These include an examination of tree-throws, slope failures, and of course the erosional face of all substantial watercourses, in particular areas where testing would be undertaken as well.

5.10.3 Residual Environmental Effects Rating Criteria

For this VEC, a *significant residual environmental* effect is a project-related disturbance to, or destruction of, an archaeological or heritage resource considered by the provincial heritage and archaeological regulators to be of major importance due to factors such as rarity, undisturbed condition, spiritual importance, or research importance, and that cannot be mitigated.



The residual environmental effects rating criteria for Archaeological and Heritage Resources was based on the regulations and spirit contained within the *Historic Sites Protection Act* and the archaeological license application process. Heritage professionals and resources regulators (Archaeological Services Unit) tend to use two main criteria for determining the significance of an archaeological site. These are: age and integrity. For example, the area of the proposed TCH may have been used in the past by pre- and post-contact Maliseet, Acadians, Loyalists, early British colonials, and more recent Euro-Canadian migrants. Because of the low number of known archaeological sites throughout the province, sites of First Nation and Acadian affiliation may be determined to be of greater importance than those sites from the later arrivals. This would be based solely on the number of known and perceived intact archaeological sites, not on the relative importance of a specific culture in the history of the province or region. For example, there is only one known, intact cellar feature of a pre-expulsion Acadian homestead that has been discovered in the Saint John River valley of New Brunswick and hence another site of this era and affiliation would likely be considered "significant" by ASU, despite the fact that there are undoubtedly other such sites in existence in the province.

Further, the integrity of an archaeological site is defined as the site remaining as close to its original state as possible, allowing for a certain amount of weathering and natural decomposition of the structures and artifacts that make up the site. These latter processes tend to act in predictable and accountable ways so that an archaeologist excavating a site can consider and allow for their potential to alter a site's appearance. The activities of heavy equipment during such groundbreaking activities as grade and excavation work, on the other hand, can have an irreversible environmental effect on the integrity of an archaeological site that would not allow for the reconstruction of the site's original appearance. Artifacts and features (non-artifact remnants of past human activities) are able to provide the most information about the sites original occupants when they have not been subject to any anthropogenic or substantive natural destructive forces. The initial phases of construction typically include grading, excavation, and the preparation of the surface for the successive phases of construction. Therefore, it is the earliest phases of construction that have the most potential to have negative environmental effects on any sites within the area of construction.

In summary, in the evaluation of the significance of environmental effects, the "significance" of the archaeological or heritage resources that may be affected as a result of the project must be determined. This determination is made by the regulating heritage authority, with input from the public, other professional archaeologists, and appropriate First Nations communities, where warranted.

5.10.4 Existing Conditions

Archaeological and heritage resources that were considered within this VEC consisted of any standing, surface or subsurface remnants from past human activities within the area proposed to be affected by the



Project. It also included palaeontological (fossil) resources. This section will briefly describe the findings of the survey and research.

Typically there are two methods for determining the existing conditions of the archaeological and heritage resources within the proposed RoW. These are:

- determine the known resources through a review of the provincial archives, provincial heritage records, documented archaeological sites, provincial and local museum records, local historical societies; community historians, and Aboriginal people; and
- undertake a search for those resources that exist, but of which we do not currently have knowledge.

Archaeological and Heritage Resources

The alignment of the proposed TCH was largely planned to avoid existing settlements and inhabited areas in order to avoid the situation of the existing TCH, that is: the presence of numerous driveways and side roads having access to the highway. In addition to this, NBDOT attempted to disrupt as few homes and homesteads as possible with the new alignment. Therefore to the degree reasonably possible, the proposed TCH is located away from existing communities. Due to the general continuity of habitation locations during the historic period, existing towns, villages, and cities are located on the same sites where the original Euro-Canadian inhabitants established those communities. The vast majority of these communities within the proposed RoW are located along the banks of the Saint John River with a variety of more recently established outlying communities distributed throughout the area. In most cases these communities are several kilometers from the proposed TCH. It is also well documented that there is considerable overlap between the settlement locations of the early European settlers and the settlement areas of First Nation peoples living in this area, particularly during the later pre-contact periods (the last 3000 years). The reason for this is very simple. Areas that would have been good settlement locations for First Nation people, would also have been attractive areas for the early colonial people to settle, such as river confluence's, large flood plains, locations close to plentiful food resources, and cross-roads (portage sites). As discussed above, the Saint John River has tended to be a focus for habitation by all peoples living in this area for the last 10,000 years.

Unfortunately there tends to be very little historical information on the settlement of the specific area of the proposed TCH. This is due to the fact that as far as can be determined, very few people lived in the area of the proposed TCH, particularly during the historic period, the period to which most documentation refers. In addition to this, beyond general documentary sources which discuss the history of the area at large (being New Brunswick, or Central New Brunswick, etc.) no specific histories related to families and events in the area of the proposed RoW were found. With respect to Aboriginal settlement and use, there are no site-specific documentary sources either. For this reason, the vast



majority of the information on the presence of heritage resources within the proposed RoW comes from the archaeological survey.

Based on our current understanding of pre-contact settlement patterns by the Maliseet First Nation people and their ancestors, habitation and living sites tend to be concentrated along the shorelines of the navigable streams and rivers. For this reason, archaeological surveys for these sites are generally focussed on these areas and thus archaeological potential modeling usually results in such areas having higher archaeological potential than those areas away from watercourses.

There are 16 registered archaeological sites within five kilometres and 29 sites within 10 kilometres of the proposed RoW. The 29 archaeological sites are a mixture of pre-contact sites identified by the presence of scattered flaked stone fragments, find-spots of individual artifacts, and historic period sites identified by the presence of artifacts. The vast majority (27) of these sites are located along the banks of the Saint John River or close to the shoreline and well away from the proposed RoW. The other two sites are located on the shoreline areas of watercourses that flow into the Saint John River. Some of these sites are not located precisely as their presence was reported to archaeologists during mid-20th-century archaeological surveys, but their exact location was not determined. Very few of these sites have been thoroughly investigated through archaeological testing and thus their exact nature, condition and chronological sequence is not known.

Only two of these sites are located within the proposed RoW. These are site CbDv 9, on the Little Presque Isle Stream, and CdDw 1, on the Lower Guisiguit Brook. Both of these sites were discovered during the archaeological survey of the proposed TCH, and thus prior to the survey, there were no known heritage resources in the proposed RoW.

During the summer of 2002, NBDOT divided the 70.7 km RoW into three sections and hired three consultants to collect the appropriate archaeological and heritage data from these sections. Additional survey and archaeological testing was required in 2003 due to realignments and the finalizing of new access road locations. The results of all the archaeological surveys are summarized in this section of the CSR. Detailed descriptions of the findings of the surveys, including such information as testpit stratigraphy, not reported here, are available in the license reports of the professional archaeologists who undertook the work. These reports are on file with the provincial government at Archaeological Services Unit, and are available to the public (Dignam and Associates Consulting 2003; Heritage Technologies Inc. 2003; JWEL 2003f).

During the various surveys six watercourses were determined to warrant testing by the archaeological teams. This determination was largely based on navigability by watercraft, during at least most of the year. The other factor considered was the topographical conditions. As can be readily observed on topographical maps of the area, many of the watercourses crossed by the proposed TCH have very steep



topographies and thus it would have been impossible for anyone to have camped along these shores. In such areas of steep topography, no subsurface testing was initiated. The watercourses tested were: Big Presque Isle Stream, Little Presque Isle Stream, Upper Guisiguit Brook, Lower Guisiguit Brook, River de Chute and Graham Brook.

The testing intervals at these watercourses ranged from 5 m to 10 m based on the ground conditions and the refinement of the archaeological potential of the area during the site visit. Areas where the ground conditions were rough, the soil depths inconsistent, and the availability of good quality camp sites was limited, were not tested as intensively as those areas which exhibited high-quality topographical attributes related to archaeological potential, such as flood-plains. As previously discussed, floodplains appear to be one of the most desirable habitation areas, given our current understanding of settlement patterns in this region. Therefore a floodplain would rate as higher archaeological potential than a narrow terrace, 10 m in elevation above the channel of a watercourse. Constraints such as ease of access and camp lay-out options may be contributing factors to this phenomenon.

Graham Brook

Due to the change in the watercourse crossing structure at River de Chute (Section 2.2.2.4) and need to make minor adjustments to the approach portions of the highway for this crossing, the proposed crossing location at Graham Brook also changed between 2002 and 2003. When the new crossing location was evaluated it was determined that the swampy nature of the valley bottom and steep slopes at the boundaries of that valley meant that there was no location where a camp-site could have been established. Thus no testing was warranted at this location, even though the previous crossing site had been tested (with negative results).

River de Chute

Due to the change in the watercourse crossing structure at River de Chute (Section 2.2.2.4), the crossing location at River de Chute changed between the 2002 and 2003 field seasons. Thus an additional assessment and further testing was warranted at this watercourse. The extremely steep and unstable slope on the south side of River de Chute right to the water's edge eliminated this shoreline from the usefulness of testing. There was only a narrow terrace area located approximately in the middle of the RoW that warranted testing on the northern shoreline of the River. No artifacts or cultural features were located along this area. Additional testing was undertaken at another terrace further north of the river shoreline that may have been formed when the water levels were higher in this valley, some time since the melting of the glaciers. It could not be determined if this terrace was old shoreline or glacial outwash, and thus testing was initiated as a precaution (Figure 5.10.1). No artifacts or cultural features were encountered during this testing.





LEGEND

- 2003 ALIGNMENT CENTRELINES
- BUILDING
- TESTPIT LOCATION

NB GRID NORTH

EXISTING ROUTE 560

STEEP SLOPE

RIVER DE CHUTE



APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
RIVER DE CHUTE

Date:
2003 10 05

Job No.:
14677

Scale:
1 : 2000

Fig. No.:
5.10.1



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Upper Guisiguit Brook

Due to the steep slope on the south side of the Upper Guisiguit Brook, testing was not warranted and only the north site of this watercourse was tested. The entire width of the RoW was tested and no cultural material was encountered (Figure 5.10.2) (Dignam and Associates Consulting 2003).

Lower Guisiguit Brook

The proposed crossing location on the Lower Guisiguit was located on the floodplain at a confluence with this watercourse and an unnamed tributary. Floodplains and watercourse confluence are typically viewed as having very high archaeological potential. During the testpitting program initiated by the consultant archaeologist, one artifact, a bifacially (flakes removed from two directions) flaked stone tool was recovered at 24 cm below the surface. This find was registered as an archaeological site, and designated as registered site CdDw 1. The site was located on the south side of the Lower Guisiguit (Figure 5.10.3). Following the recovery, and the notification of the provincial regulator (who subsequently notified the Maliseet Advisory Committee on Archaeology) a more intensive investigation of the area of the find was initiated. The 50 cm by 50 cm square testpits in the immediate area of the find were expanded into 1 metre square units and additional 1 metre square units and 50 cm testpits were placed in the area as well. Two bones (one avian and one small mammal) were recovered during this testing, however, both were of recent origin and not archaeological. The only archaeologically relevant finding from this additional work was the recovery of one stone flake in the expanded testpit (Dignam and Associates Consulting 2003).

Big Presque Isle Stream

As a result of a project design change, the crossing location for the Big Presque Isle stream was moved downstream between the summer of 2002 and 2003 and thus the new crossing required examination by an archaeologist. The walkover revealed that the stream is located at the bottom of a very steep gorge. The north side, in particular was steep right to the water's edge for approximately half of the width of the RoW. The eastern portion was tested where a narrow terrace area held some potential for archaeological resources. Nothing cultural was encountered. The slope on the south side was interrupted by the presence of a small terrace, which occupied only the middle portion of the RoW. This area was only about 5 to 10 m wide. In testpit (Tp) #3 on this side a collection of 39 square nails was encountered in the top layer of the testpit (Figure 5.10.4). Additional testing adjacent to Tp #3 located five more nails of the same style and condition. No other nails or artifacts were recovered in any of the other 19 testpits at this stream.



Following the completion of the testing at the stream, the nails were examined in the lab. All are square cut nails, from 7-10 cm in length, with the exception of one large round 15 cm spike. Although natural corrosion was evident on the nails, they do not show any sign of actually having been used. The fact that there is no surface evidence of a structure in the area, no obvious access to a structure, other than the stream, no other construction material encountered, and that the nails do not appear to have been used suggests that they may have been part of a barge or boat load of construction material being floated up or down the stream to another location. They were likely boxed together and fell off the barge and floated or ice brought them to this location. The box would have rotted eventually and a pile of nails would have remained. Although square cut nails were beginning to become widespread by the mid-19th century, the presence of a large round nail amongst them, suggests a late 19th century timeframe, possibly the 1880's.

Little Presque Isle Stream

There are two crossings of this watercourse by the proposed Project. One crossing is for the main highway lanes, the other for a connector road for the Town of Hartland. Both sides to the crossing location were tested (Figure 5.10.5). No cultural material was encountered.

Due to the steep approach slope on the east side of the stream at the interchange access road location, no testing was warranted. One pre-contact period artifact was recovered from the western shoreline site at this crossing location of the Little Presque Isle Stream (Figure 5.10.6). The artifact, a ground-stone axe, was located during a routine examination of the erosional face of the watercourse. Subsequent testing (with a combination of regular and expanded testpits) of the bank area above the find location as well as along the stream's edge for the width of the RoW did not recover any additional artifacts, nor were any features encountered. This site has been registered as site CbDv 9 and will likely be classified as a find-spot; that is a location where an individual artifact has been recovered, yet no other artifacts nor features appear in the area in association with the artifact (Heritage Technologies Inc. 2003).

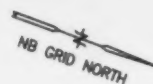
Walkover of the Proposed TCH

The proposed RoW, as determined at the time of the survey, was subject to a 100% walkover. The objective of this effort was to attempt to confirm the results of the archaeological modeling exercise by: 1) locate surface features (both cultural and/or naturally significant) not visible on mapping and aerial photographs; and 2) gather new information which, if conflicting with the data used in the model could be used to re-evaluate the model. During this exercise, the cut line of the RoW was walked by the archaeological teams with transects across the RoW examined at varying intervals, as ground conditions warranted. In addition, woods roads were examined and areas of abandoned farmland were inspected for surface features such as old structures, and family burial plots. In addition, topographical



LEGEND

- 2003 ALIGNMENT CENTRELINES
- TESTPIT LOCATION



APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
UPPER GUISIGUIT BROOK

Date:
2003 10 03

Job No.:
14677

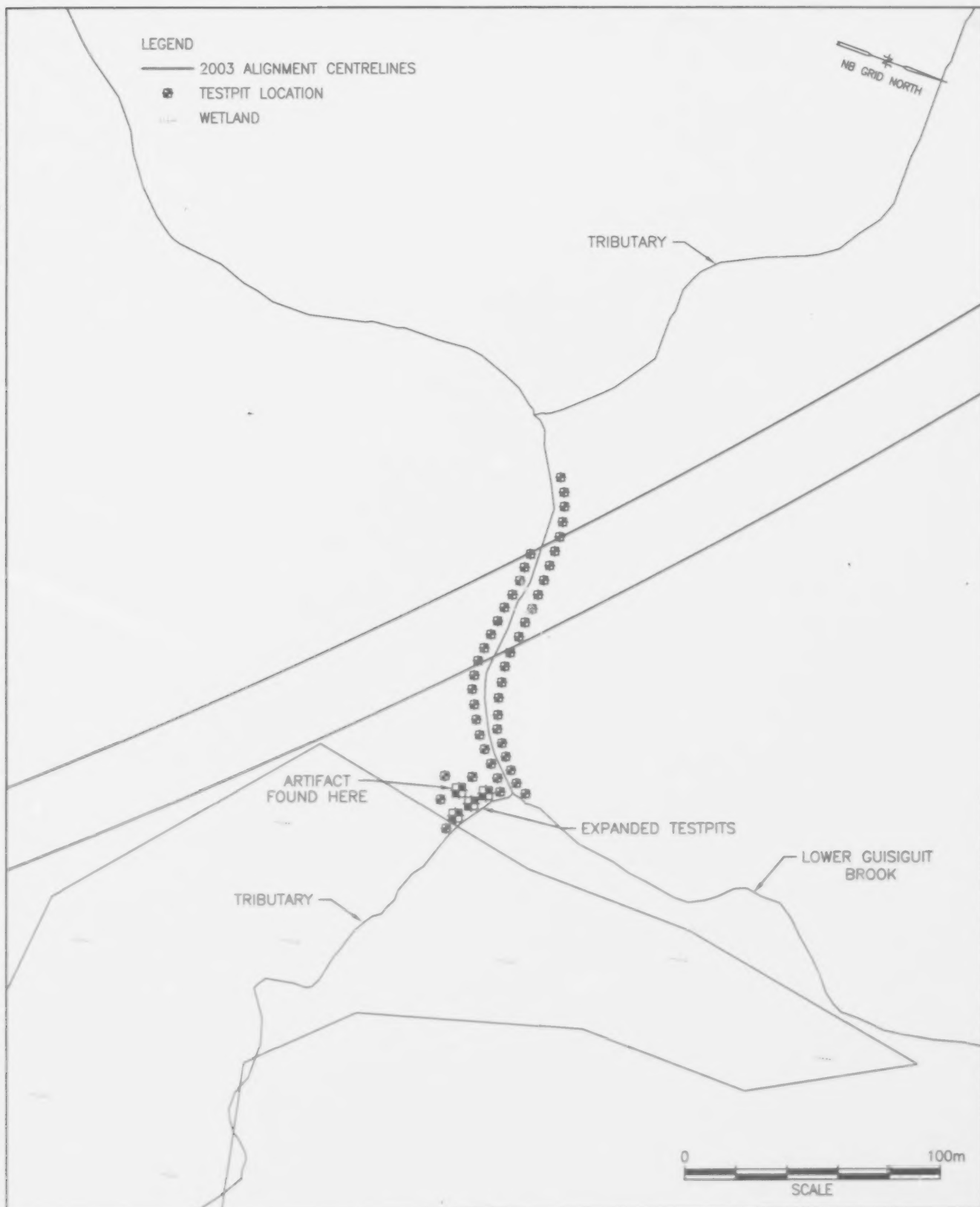
Scale:
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**APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
LOWER GUISIGUIT BROOK**

Date:
2003 10 03

Scale:
1 : 2000

Job No.:
14677

Fig. No.:
5.10.3



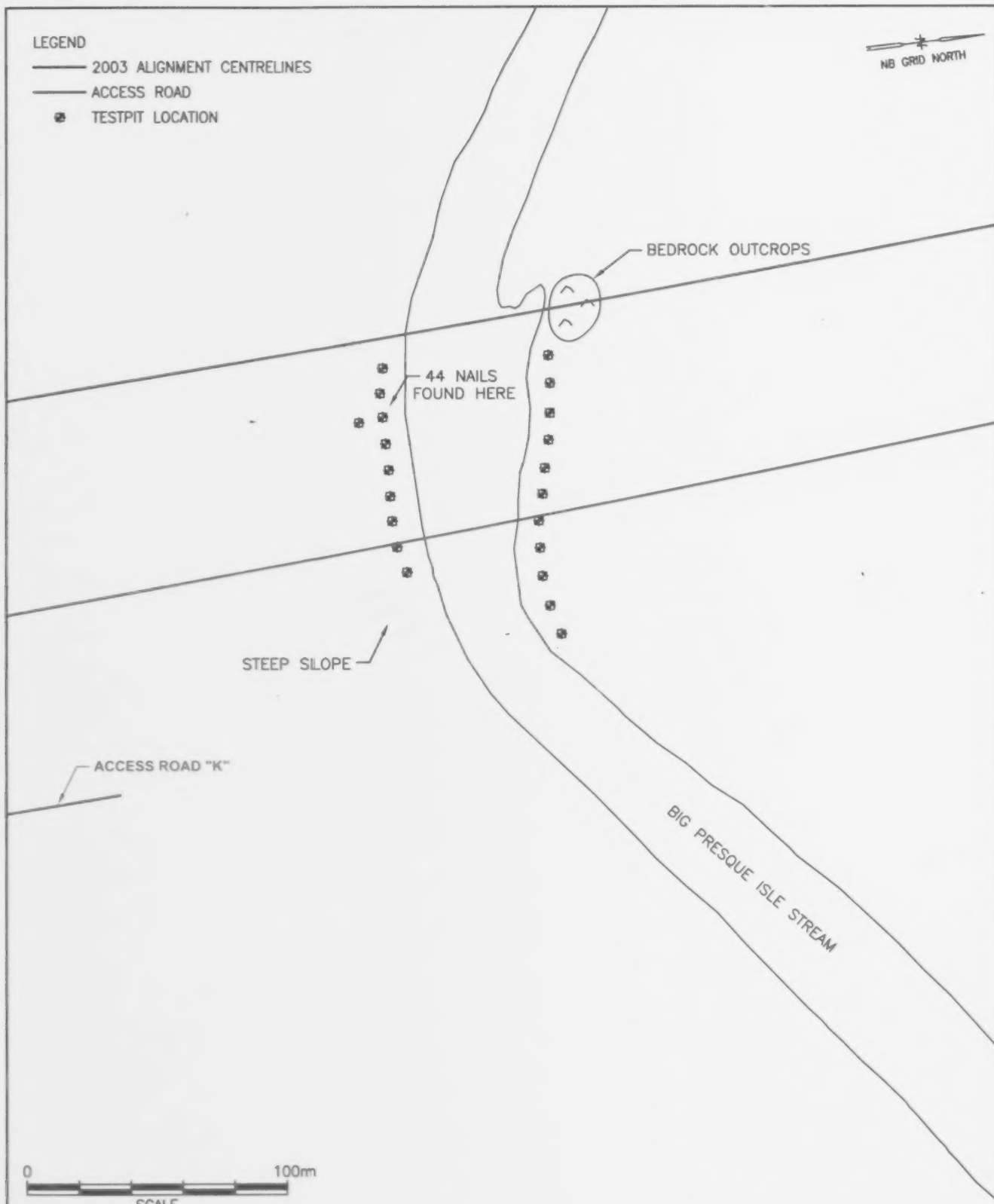
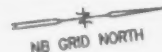
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LEGEND

- 2003 ALIGNMENT CENTRELINES
- ACCESS ROAD
- TESTPIT LOCATION



APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
BIG PRESQUE ISLE STREAM

Date:
2003 10 03

Job No.:
14677

Scale:
1 : 2000

Fig. No.:
5.10.4



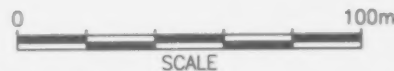
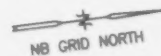
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LEGEND

- 2003 ALIGNMENT CENTRELINES
- TESTPIT LOCATION
- BUILDING
- WETLAND



APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
LITTLE PRESQUE ISLE STREAM
(FOUR-LANE HIGHWAY CROSSING)

Date:
2003 10 05
Job No.:
14677

Scale:
1 : 2000
Fig. No.:
5.10.5

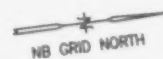


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- 2003 ALIGNMENT CENTRELINES
- TESTPIT LOCATION



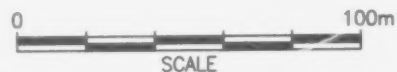
HARTLAND CONNECTOR ROAD

EXPANDED TESTPITS

ARTIFACT FOUND HERE

STEEP SLOPE

LITTLE PRESQUE ISLE STREAM



APPROXIMATE LOCATION OF ARCHAEOLOGICAL
TESTPITS
LITTLE PRESQUE ISLE STREAM
(HARTLAND CONNECTOR ROAD CROSSING)

Date:
2003 10 05

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Scale:
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Fig. No.:
5.10.6



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information was evaluated for such natural features as old watercourse channels, glacial melt-water beaches and any other information that might be relevant to the heritage assessment of the proposed RoW, including new access roads.

In many areas within the proposed RoW where agricultural fields dominated the landscape, the proposed TCH was routed in an attempt to avoid as much cropland as reasonably possible. During the walkover of these areas, in particular in the southern portions of the RoW, the reason there were no fields in those areas became very obvious as the alignment tended to be in low areas of poor drainage and had very low potential for archaeological resources. Many of the forested areas in the northern sections of the RoW were located on areas well elevated above the navigable rivers and streams in the area, and also scored low for archaeological potential, particularly for pre-contact resources.

Several features related to abandoned farming activities during the 19th and early 20th centuries were encountered during the walkover. These mainly included such things as field-clearing rock piles, cedar rail fencing, and pagewire fencing. Based on the cut line chainages (westbound lane) marked on the survey stakes encountered, fieldstone piles/fence lines appeared at 239+175, 239+050, 231+400, 230+825, 228+725, 225+925, 209+250, 208+550, 208+400, 207+650, 207+550, and 206+900. The ground around these features was generally very flat and in various states of regeneration. The stone pile at 207+550, for example, was over 6 m in diameter and 2 m high in its middle. Considerable effort and/or time had obviously been spent preparing and maintaining that field for agricultural purposes. Some of the fields had clearly not been maintained for a long time, possibly as much as 100 years, based on the size of the trees growing within them. Others appeared to have been abandoned within the last 20 years. The ground around all of these abandoned fields was thoroughly examined for indications of surviving structures associated with agriculture and in particular for any evidence of family burial plots. The potential for such sites is low given the establishment of churches and burial grounds concurrently with the settlement of these areas, however, it was necessary to confirm this presumption.

Where plowed fields were encountered during the walkover, a transect system of walking was established to see if any archaeological sites had been encountered during this process and if any surface artifacts could be seen. This methodology of walking over plowed fields looking for artifact scatters has long been successfully practiced in areas such as southern Ontario and the eastern US. Although there is no tradition of this methodology in New Brunswick, it is a worthwhile approach when the opportunity presents itself. No significant archaeological resources were discovered during this procedure. The fieldstone piles and old fence lines that were encountered are not considered historically significant enough to warrant changes to the Project.

One potential palaeo-shoreline area was encountered during the walkover in 2002 in the area south of Demerchant Brook (Figure 5.10.7). This area was investigated in 2003 with the assistance of Quaternary geologist Allan Seaman of the NBDNR. During Mr. Seaman's examination of the area,



which included subsurface testing, he determined that the area consisted of basal lodgment till, material that was pushed to that location by a glacier and thus it would not have been part of a palaeo-shoreline. In addition to this, it was noted that the area had been plowed, likely in the 19th century based on the size of the trees in the area. Based on the fact that the area was not a paleo-shoreline, testpitting for cultural features or artifacts was not warranted along this area. In addition to this, the proposed alignment has moved approximately 250 m to the east at this location. The archaeological team inspected the proposed new RoW alignment, however, due to the steep slope in this area, no similar concerns were raised and no additional investigation is warranted.

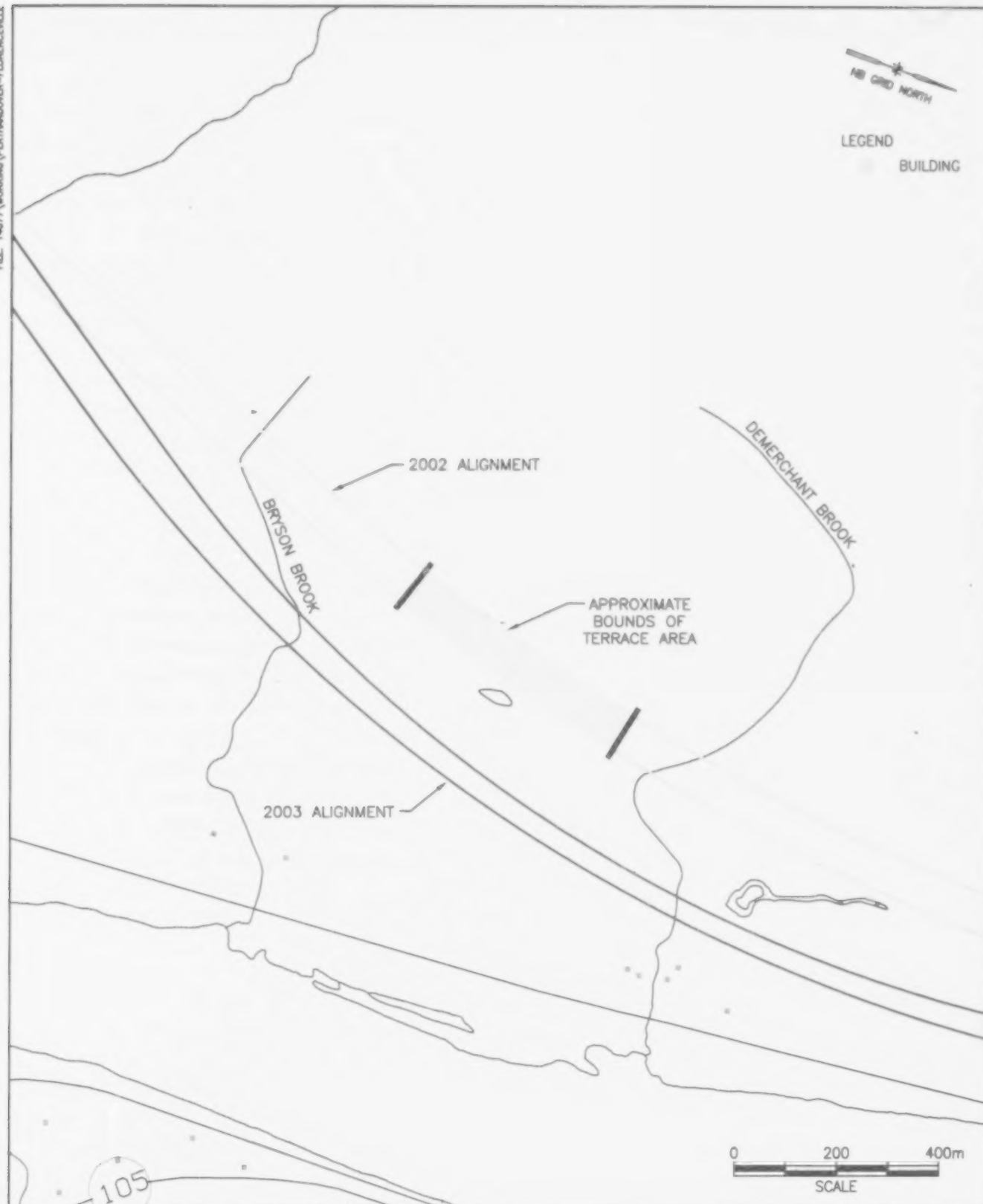
A wooden structure described as a maple sugar camp was encountered at the Stairs Road (for location Figure 3.2B, Appendix C), however, it is not considered to be an important heritage resource. One informant stated that the remains of an old house (including a cellar) with various outbuildings was also located at the Stairs Road. A surface examination of this area failed to encounter these features and it is presumed that they likely lie outside of the proposed RoW. Various historic period artifacts were encountered during testing at the Sipprell Road crossing location, however, they all appeared to be 20th century in origin, and therefore no changes to the proposed alignment has been recommended at this location.

The remains of an old lumber mill were encountered within the RoW, approximately 4 km north of the Raymond Road (Figure 3.2C, Appendix C). The site is located next to an abandoned farm property upon which there was a house and outbuildings. A local informant stated that he was sure that no cellar feature existed for the house and that the house and other buildings were located away from the proposed RoW. Given that the potential to encounter surface features was minimal, no extensive surface examination for any remains of the house was initiated. The lumber mill site is visible on the surface in the form of a 3.8 by 6.8 stone foundation, with some metal fragments from various pieces of equipment in the area as well. According to a local resident, there was a water well in the area that was used to draw water, which in turn was boiled to produce steam to drive the saw in the mill. The archaeological team was unable to locate the well. Given the quality and "living memory" of the local lore on this site, it likely dates to the mid- to late 19th century. The site has been recorded, sketched, and photographed for archival purposes. Little remains of the structure and no change to the proposed alignment is recommended for this location.





LEGEND
 BUILDING



**APPROXIMATE BOUNDS OF POTENTIAL
 TERRACE AREA, DEMERCHANT BROOK
 NEW ROUTE 2 TRANS-CANADA HIGHWAY
 PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:	Scale:
2003 10 05	1 : 10 000
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14677	5.10.7

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Access Roads

There are 19 proposed new access roads associated with the proposed Project (Figures 3.2 A-D, Appendix C). All of these roads are to provide access to land where current access will be cut off as a result of the proposed TCH. Many of these roads parallel the existing RoW and thus many of the locations of the access roads were surveyed during the earlier field visits. Almost all of these new roads are located away from significant watercourses and are in areas considered to have low potential for archaeological resources. Access Road J did cross Hunter Brook (Figure 3.2C, Appendix C), however the watercourse could not be considered navigable at the crossing location. The west side of the watercourse crossing was very steep right to the waters edge and thus no testpitting was warranted. The north side consisted of a series of abandoned high water channels with small terraces in between. The water was very close to the surface in this area. Two testpits were placed on the eastern shoreline area. No cultural material was encountered.

There was evidence of past and relatively recent forest harvesting activities observed throughout the forested portions of the RoW during the walkover. Obviously this activity is well documented throughout the province and it is not considered historically significant.

As with most archaeological surveys, there is an element of uncertainty regarding the field portions of the assessment and therefore despite the apparent lack of any remaining significant heritage resources along the proposed alignment, there remains a limited potential for encountering such resources during the groundbreaking phases of construction within the proposed RoW. In order to address this issue it is recommended that in the unlikely event archaeological materials are encountered during any groundbreaking phases of the construction work related to the Project, Section 7.6(f) of the EPP be followed by construction workers and supervisory personnel on the site. This section states that in the event of a discovery of an archaeological nature, work in the area of the discovery shall be halted and the provincial regulating agency contacted for assistance and guidance.

Architectural Heritage

Despite NBDOT's efforts to avoid existing homesteads, structures (houses, garages, various outbuildings) were encountered on 34 of the properties crossed by the proposed RoW. These have to be removed as a result of the proposed Project. In all circumstances, these structures are located within the proposed RoW and realigning the proposed TCH at these locations was not feasible.

Nineteen houses on properties that were crossed by the alignment will be removed from the property and placed elsewhere. Only one house was torn down. This house was a Georgian-style home and is reported as being approximately 100 years old. Georgian style houses and various imitation styles have been constructed in New Brunswick since the arrival of the Loyalists in the late 18th century and are still very popular. The house that was torn down, located on Route 560 at Jacksonville, did not possess any



unique attributes that warranted preservation and the house was in relatively poor condition. There was an addition on the back of the house that was of an inconsistent style and the interior had been modified to accommodate its alteration into apartments. There are additional properties for which the sale of the property has not been completed at the time of this study.

None of the houses affected by the Project are on the Canadian Inventory of Historic Buildings. Based on the review of these building, most were of relatively recent construction (post-1945), were bungalows or similar design and are not of historical or architectural significance. Some of the homes were approximately 100 years old. At this time it has not been determined if any of the 19 sold properties with houses possess any features of architectural significance, however, since the houses were not destroyed, there is no loss to architectural heritage of the properties. For those properties where the sales have not been completed, none are on the Canadian Inventory of Historic Buildings, most are of relatively recent construction and some are mobile homes. None are believed to be of architectural significance.

Palaeontological Resources

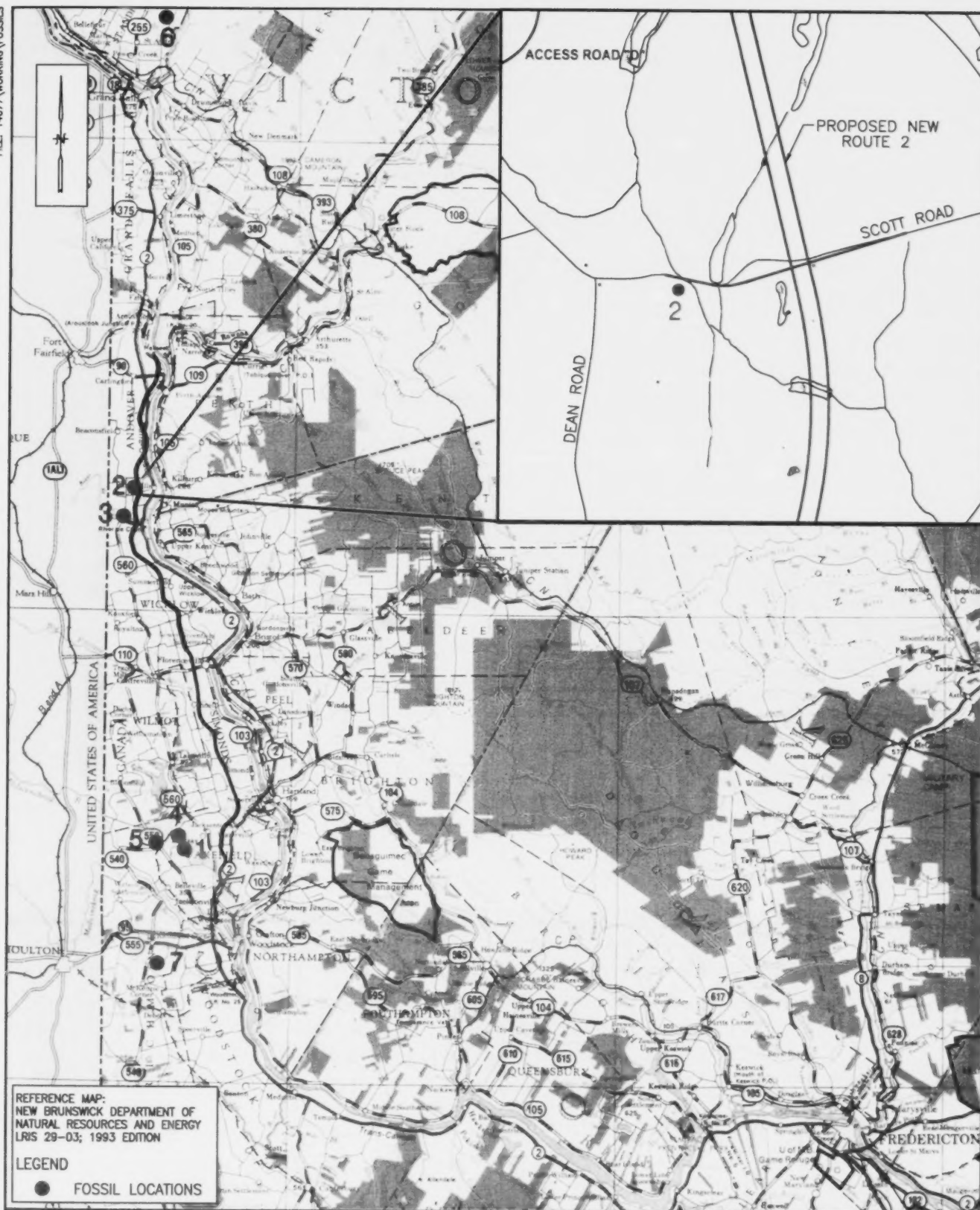
Five sites that are known to contain palaeontological resources have been recorded by provincial agencies within 10 km of the proposed TCH (Figure 5.10.8). The closest known fossil site is located approximately 420 m west of the proposed new underpass at Scott Road. This site produces fossils of corals and crinoids from the Silurian and Devonian periods. It is very unlikely that this site will be affected by the proposed Project. Given that similar rock formations will be exposed in the area during the blasting of the required grade cuts in areas where bedrock is close to the surface, there is the potential for new fossil producing rock to be exposed here and throughout the length of the proposed TCH. Rock cuts exposed as a result of blasting activities associated with construction are often sought out by geologists studying the area, since there tend to be few natural phenomenon in this area that expose these sedimentary layers for scientists to study. While some individual fossils will potentially be destroyed during blasting, the rock formations that contain these fossils are extensive and spread throughout this area.

5.10.5 Environmental Effects Analysis

5.10.5.1 Project-VEC Interactions

This section evaluates the significance of potential residual environmental effects resulting from Project interactions with the Archaeological and Heritage Resources VEC. The proposed mitigation, consisting of the pre-construction survey and the implementation of the archaeological protocol presented in Sections 7.6 and 8.3 of the EPP, are included within the analysis.





**PALAEONTOLOGICAL RESOURCES IN AREA
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK**

Date:
2003 10 05

Job No.:
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Scale:
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Fig. No.:
5.10.8



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PALAEONTOLOGICAL RESOURCES IN AREA
NEW ROUTE 2 TRANS-CANADA HIGHWAY
PROJECT PERTH-ANDOVER TO WOODSTOCK

Scale:
N.T.S.

Fig. No.:
5.10.8



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Table 5.10.1 illustrates that only groundbreaking activities have the potential for interaction with the Archaeological and Heritage Resources VEC during construction and for accidents, malfunctions and unplanned event only.

Table 5.10.1 Project Activity – Environmental Effects Interaction Matrix for Archaeological and Heritage Resources

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>ARCHAEOLOGICAL AND HERITAGE RESOURCES</u>	
Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	Potential Environmental Effect Project Related Change in Archaeological and Heritage Resources
Construction	
Site Preparation	✓
Roadbed Preparation	
Surfacing and Finishing	
Watercourse Crossing Structures	✓
Ancillary Structures and Facilities Construction	✓
Operation	
Winter Safety	
Proposed TCH Presence	
Maintenance	
Proposed TCH Maintenance	
Vegetation and Wildlife Management	
Accidents, Malfunctions and Unplanned Events	
Hazardous Material Spills	✓
Disturbance of Archaeological or Heritage Resources	✓

5.10.5.1.1 Construction

A substantial amount of the construction associated with the proposed Project involves groundbreaking. Clearing has the potential to disturb subsurface soils due to soft ground conditions in wet soils and along watercourse shorelines, although measures in place as described in the EPP to prevent erosion and sediment problems, will often address the issues related to soil disturbance in these areas. The potentially most destructive phase of construction is the establishment of grade. This work involves the movement of large amounts of soil and rock within the footprint to achieve the ground elevation levels required by the design of the proposed TCH. By far most archaeological sites are located in the upper portions of the soil stratigraphy, in those layers of soil deposited since the retreat of the glaciers, 11,000 years ago. The blasting of rock encountered below the covering soils is typically not a concern, as subsurface rock will not contain any archaeological evidence. Therefore, following the removal and disruption of the upper soil layers, there is no further concern for any interactions between the Project and this VEC.



As discussed previously, shorelines often have high archaeological potential given that watercourses were the main transportation routes during pre-contact and the early historic period throughout the region. All watercourses that are to be crossed by the proposed Project will require a structure of some type to be installed within or over the channel. These structures usually require relatively complicated installation procedure with a lot of construction equipment. Therefore there is the potential for an interaction with heritage resources at the watercourse shoreline.

There are various facilities associated with the proposed Project such as marshalling yards, weigh scales, aggregate sources, and new access roads. Most of these areas will be located within the RoW and were therefore included within the modeling and archaeological surveys undertaken. Any facilities, such as the aggregate extraction areas, which have not been identified, will be reviewed once their location has been determined. If, during a preliminary archaeological survey, any significant heritage resources are encountered at the proposed location, then appropriate mitigation will be implemented or another aggregate site will be chosen.

5.10.5.1.2 Operation

The activities associated with the later phases of the project such as the surfacing and finishing of the proposed TCH and those associated with the operation and maintenance of the proposed TCH are not anticipated to affect archaeological and heritage resources since no new groundbreaking activities will take place during this construction phase. Therefore there is no interaction between the operational phase of the project and the VEC and thus there is virtually no potential for environmental effects to archaeological and heritage resources during normal activities associated with this activity.

5.10.5.1.3 Maintenance

Within the normal activities associated with highway maintenance, there will be no interaction between this phase of the Project and the VEC.

5.10.5.1.4 Accidents, Malfunctions and Unplanned Events

Table 5.10.1 demonstrates that there is a pathway between the preliminary groundbreaking activities associated with construction and the Archaeological and Heritage Resources VEC in the case of an accident or unplanned event. Examples of Accidents and Malfunctions include the spill of a material that requires a clean-up (e.g., Petroleum Oil Lubricant (POL)) or the potential for off-RoW vehicle movement. An unplanned event that could have the potential to affect this VEC is the disturbance of an unknown archaeological resource during the groundbreaking phases of construction.



5.10.5.2 Environmental Effects Analysis and Mitigation

The following tables in this section provide the environmental effects matrix for the Project activities that could potentially interact with the Archaeological and Heritage Resources VECs. The sections have been divided into the interaction activities: Construction, Accident and Unplanned Events. The text following each table provides a discussion of the environmental effects and mitigation outlined in the matrix.

5.10.5.2.1 Construction

Table 5.10.2 Environmental Effects Assessment Matrix for Archaeological and Heritage Resources (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>Archaeological and Heritage Resources</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Site Preparation	Disturbance or destruction of a significant archaeological or heritage resource (A)	- Pre-construction archaeological survey - Archaeological monitoring at Little Presque Isle and Lower Guisguet Stream - All construction activities will be carried out in accordance with Sections 7.6 and 8.3 of the EPP	1	1	1/1	1	2
Watercourse Crossing Structures	Disturbance or destruction of a significant archaeological or heritage resource (A)	- Pre-construction archaeological survey - Archaeological monitoring at Little Presque Isle and Lower Guisguet Stream - All construction activities will be carried out in accordance with Sections 7.6 and 8.3 of the EPP	1	1	1/1	1	2
Ancillary Structures and Facilities Construction	Disturbance or destruction of a significant archaeological or heritage resource (A)	- Pre-construction archaeological survey - All construction activities will be carried out in accordance with Sections 7.6 and 8.3 of the EPP	1	1	1/1	1	2



Table 5.10.2 Environmental Effects Assessment Matrix for Archaeological and Heritage Resources (Construction)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>Archaeological and Heritage Resources</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Key: Magnitude: 1 = Low: e.g., minor impairments to cultural resources appreciation or affects to non-significant historic period heritage feature, e.g., stone fence line, field stone pile; loss of individual artifact. 2 = Medium: e.g., loss of historic or cultural resources not of major importance or pre-disturbed heritage site, artifacts present, however, no or little chance of intact features. 3 = High: e.g., intact "significant" heritage site, pre-contact and/or contact period, features present, portion or all of site will be destroyed or lost. Geographic Extent: 1 = < 1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = > 10,000 km² Frequency: 1 = < 11 events year 2 = 11 - 50 events year 3 = 51 - 100 events year 4 = 101 - 200 events year 5 = > 200 events year 6 = continuous Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = > 72 months Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Site preparation and construction will require clearing, grading, soil removal and deposition, and structure construction at watercourses. Clearing and grading will disturb the integrity of the subsurface soils which may result in the disturbance or loss of archaeological and heritage resources. The archaeological survey completed by the three consulting companies reviewed the entire RoW and included a comprehensive testpitting survey of the areas of high archaeological potential (Dignam and Associates Consulting 2003; Heritage Technologies Inc. 2003; JWEL 2003f). No significant archaeological or heritage resources were identified during the study survey along the RoW. Therefore it is not anticipated that there will be any adverse environmental effects to the Archaeological and Heritage Resources VEC during the construction phase of the Project.

Navigable watercourses tend to score high on archaeological modeling exercises, pending verification of ground conditions during a field visit. These areas were thoroughly examined by the various archaeological teams. Shoreline areas were tested, where appropriate, and all soils screened through ¼ inch mesh to ensure that no artifacts were missed. The artifact and the flake recovered from the Lower Guisguet Brook crossing location appear to be isolated finds and not representative of a larger archaeological site. Based on the findings of the consultant archaeologist, there is no recommendation to change the proposed alignment at this watercourse (Dignam and Associates Consulting 2003). However it is recommended that an archaeologist monitor the initial groundbreaking phases of construction at this location. Based on the results of the pre-construction survey and the monitoring



recommendation, no adverse environmental effects to this VEC are anticipated at this watercourse crossing location as a result of the Project.

The groundstone axe recovered in the riverbank at the connector road to Hartland, which crosses the Little Presque Isle Stream, appears to be an isolated find and not representative of a larger archaeological site. When individual pre-contact period artifacts are encountered in this manner, they are presumed to have been lost or discarded by their original users. In this case, since no other evidence of use or occupation of the area was found during the additional testing regime, it appears that there is no further evidence to be gathered from the location. Therefore, no changes to the proposed alignment have been recommended at this watercourse crossing location (Heritage Technologies Inc. 2003). The provincial regulating agency for archaeology has accepted all the recommendation of the consultants' archaeological license reports. However it is recommended that an archaeologist monitor the initial groundbreaking phases of construction at this location. Based on the results of the pre-construction survey and the monitoring recommendation, no adverse environmental effects to this VEC are anticipated at this watercourse crossing location as a result of the Project.

Architectural Heritage

To date only one house was demolished as a result of the Project and it was of a style common throughout New Brunswick. None of the remaining structures to be removed are considered to be architecturally significant. Thus, no significant adverse environmental effects to architectural heritage are anticipated as a result of the Project.

Palaeontological Resources

Based on the abundant nature of the bedrock formations, within which these resources exist in the area of the Project, it is not anticipated that any significant palaeo-environmental information will be lost as a result of the Project.

Based on the results of the archaeological assessment and fieldwork, the potential for the construction of any Project ancillary facilities to result in Project-related environmental effects to this VEC is low. Although the proposed alignment does cross several areas determined to have medium to high potential for archaeological resources, these areas were thoroughly examined by professional archaeologists and no significant resources were encountered. Any ancillary resources related to the project that have not been determined at this time will be subject to an environmental review prior to any groundbreaking construction activities. Therefore it is not anticipated that there will be adverse environmental effects to the archaeological and heritage resources as a result of the Project.



Based on this analysis, the residual environmental effects of the Project on the Archaeological and Heritage Resources VEC are considered as not significant

5.10.5.2.2 Accidents, Malfunctions and Unplanned Events

Table 5.10.3 Environmental Effects Assessment Matrix for Archaeological and Heritage Resources (Accidents, Malfunctions and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: <u>Archaeological and Heritage Resources</u> Phase: <u>Accidents, Malfunctions and Unplanned Events</u>							
Project Activity (See Table 4.1.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Hazardous Material Spills	Disturbance or destruction of a significant archaeological or heritage resource (A)	- Pre-construction archaeological survey - All construction activities will be carried out in accordance with Sections 7.6 and 8.3 of the EPP	1	1	1/1	1	2
Disturbance of Archaeological or Heritage Resources	Disturbance or destruction of a significant archaeological or heritage resource (A)	- Pre-construction archaeological survey - Archaeological monitoring at Little Presque Isle and Lower Guisguet Stream - Marking of RoW boundary during construction - All construction activities will be carried out in accordance with Sections 7.6 and 8.3 of the EPP	1	1	1/1	1	2
Key: Magnitude: 1 = Low: e.g., minor impairments to cultural resources appreciation or affects to non-significant historic period heritage feature, e.g., stone fence line, field stone pile; loss of individual artifact. 2 = Medium: e.g., loss of historic or cultural resources not of major importance or pre-disturbed heritage site, artifacts present, however, no or little chance of intact features. 3 = High: e.g., intact "significant" heritage site, pre-contact and/or contact period, features present, portion or all of site will be destroyed or lost. Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

The archaeological resources that may be affected as a result of an unplanned event are individual artifacts as opposed to archaeological sites containing features (non-removable in-ground evidence of human use and occupation such as fire pits and living floors). While the potential exists for individual



artifacts to have been missed during the survey, the potential for encountering archaeological or heritage sites during these accidental or unplanned events is considered low due to the intensity of the subsurface testpitting in areas of high archaeological potential. A spill of a material that requires a clean-up, any groundbreaking work outside of the area surveyed, and the unplanned discovery of an archaeological site within the RoW are events that could adversely effect archaeological resources. Spills requiring clean-up are most likely to occur within the footprint of the RoW where vehicle and equipment will be used and parked. Due to the precautions taken by developers, spills tend to be infrequent and minor, and therefore only limited ground disturbance is required to mitigate these situations. Off RoW vehicle movement is not anticipated to have an adverse environmental effect on the VEC. The RoW limits in forested areas will be clearly staked and/or flagged and only those areas required for construction will be cleared. In areas adjacent to agricultural fields, the RoW boundary will be clearly indicated and personnel driving heavy equipment will be instructed to stay within the construction zone. Developer or NBDOT personnel who encounter a potential heritage resource are instructed to follow the protocols outlined in Section 8.3 of the EPP. Therefore, while disturbance to any important archaeological or heritage resources as a result of an accident, malfunction or unplanned event could be significant, it is very unlikely to occur, given the implementation of mitigation such as the pre-construction archaeological survey, the RoW boundary delineation, and the archaeological protocol described in Section 8.3 of the EPP.

Based on this analysis, the residual environmental effects of the Project on the Archaeological and Heritage Resources VEC are considered as not significant

5.10.5.3 Determination of Significance

The overall results of the environmental assessment for the archaeological and heritage resources are presented in a summary matrix, Table 5.10.4. The residual environmental effects of the Project are considered as unlikely and not significant.

Table 5.10.4 Residual Environmental Effects Summary Matrix for Archaeological and Heritage Resources

Residual Environmental Effects Summary Matrix Valued Environmental Component: ARCHAEOLOGICAL AND HERITAGE RESOURCES				
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	1	3
Operation	N/A	N/A	N/A	N/A
Maintenance	N/A	N/A	N/A	N/A
Accidents, Malfunctions and Unplanned Events	NS	3	3	3
Project Overall	NS	3	3	3



Table 5.10.4 Residual Environmental Effects Summary Matrix for Archaeological and Heritage Resources

Residual Environmental Effects Summary Matrix			
Valued Environmental Component:		ARCHAEOLOGICAL AND HERITAGE RESOURCES	
Phase	Residual Environmental Effects Rating	Level of Confidence	Likelihood
			Probability of Occurrence
Key		Probability of Occurrence: based on professional judgement	
Residual Environmental Effect Rating:		1 = Low Probability of Occurrence	
S = Significant Adverse Environmental Effect		2 = Medium Probability of Occurrence	
NS = Not-significant Adverse Environmental Effect		3 = High Probability of Occurrence	
P = Positive Environmental Effect			
Level of Confidence		Scientific Certainty: based on scientific information and statistical analysis or professional judgement	
1 = Low Level of Confidence		1 = Low Level of Confidence	
2 = Medium Level of Confidence		2 = Medium Level of Confidence	
3 = High Level of Confidence		3 = High Level of Confidence	
		N/A = Not Applicable	
*As determined in consideration of established residual environmental effects rating criteria.			

5.10.6 Monitoring and Follow-up

During the study no features of archaeological or heritage significance were noted. The two locations where pre-contact archaeological artifacts were encountered have been mitigated to the satisfaction of the provincial archaeological regulating agency, and no further testing is recommended. However, it is recommended that an archaeologist monitor the initial groundbreaking phases of construction at these two watercourses, the Lower Guisguait and Little Presque Isle River (Hartland connector road). With the exception of the navigable watercourse crossing with habitable topography which were thoroughly examined and tested, most of the RoW appears to have low to moderate potential for the presence of significant archaeological and heritage resources.

If a suspected archaeological / heritage resource is encountered during construction, it is recommended that the procedures described in Section 8.3 of the EPP be followed, including the cessation of construction activities in the area of the discovery and contacting the provincial regulating agency of archaeological resources.



5.11 Labour and Economy

5.11.1 Rationale for Selection as Valued Environmental Component

Labour and Economy was selected as a VEC to assess the potential interactions between Project activities and the current labour and economic conditions within the areas that may be affected as a result of the Project.

"Labour" refers to the supply base and the demand of the direct skilled and non-skilled labour requirements of the Project, as well as the direct labour income generated and the indirect creation of labour in other economic sectors. "Economy" refers to the changes to the production base of the region and province other productive sectors generated by the Project expenditures on materials and services attained within the local, regional and provincial economies. This also includes the net Project labour income expenditures resulting from changes in expenditure patterns in local and regional markets. "Economy" also refers to the productivity and cost saving benefits to the local economy from an improved infrastructure.

In this section, the environmental and economic effects of the Project activities on Labour and Economy resulting from the construction, operation, and maintenance, as well as accidents, malfunctions and unplanned events are assessed.

5.11.2 Environmental Assessment Boundaries

5.11.2.1 Spatial and Temporal

The spatial boundary of the Project for the Labour and Economy VEC is the regional economy of Carleton and Victory counties in the upper Saint John River Valley of New Brunswick. Due to technical limitations described in the next section, the indirect "spin-off" effects of Project expenditures on materials, services and labour may extend beyond the local region to the rest of the Province.

The temporal boundaries of the Labour and Economy VEC include the four year construction period of the Project, as described in Section 3.0, and operations and maintenance in perpetuity.



5.11.2.2 Administrative and Technical

The Project is located within Carleton and Victoria counties. The estimation of monetary value and employment numbers associated with changes in economic sectors affected by the construction, operation and maintenance, malfunctions, accident and unplanned events and incidents, are beyond the administrative scope of this study. To quantify economic effects would entail very time consuming and costly market research and analysis, which would extend well beyond the administrative time line boundaries of this study. Statistics Canada maintains an Input-Output model of the production input and output of all National and Provincial economic sectors. This input-output model can be used to measure the indirect "spin-off" labour and economic effects of an extraneous change in activity, as is the case with the injection of Federal and Provincial public expenditures into the highway construction economic sector. The input-output model analysis is limited to sectoral results at the Provincial level only.

Much of the data used in this CSR was gathered and generated from various government and non-government organizations (*e.g.*, the Carleton Victoria Forest Products Marketing Board (CVFPMB), an administrative and wood supply management area that encompasses the Carleton and Victoria Counties of New Brunswick). It must also be noted that personal communications from various individuals during public and stakeholder interviews form part of the data set. The validity of unconfirmed data was weighed by the authors for its applicability and reliability for use in this EA.

As presented in Section 5.8 Land Use, the spatial information used for the detailed assessment of Project-related environmental effects on both agriculture and forestry includes the proposed TCH footprint (1,054 hectares including access roads), in the context of twenty digital map tiles (78,894 ha) based on NBDNR 1996 and 2000 aerial photography ("Assessment Area") that provides a larger contextual view of the area traversed by the Project. Agriculture and forestry data are based on land-use and forest cover information from the digital data, while sector and economic information is based on NB Department of Agriculture, Fisheries and Aquaculture and Statistics Canada 2001 Agriculture Census data. Forestry activities span rotations in excess of fifty years and agricultural activities are based on shorter crop rotation schedules - three to five years covers most productions. Assumptions used reflect current sectoral soil and water conservation best management practices (BMPs).

Data on the affected regional economy of western New Brunswick was obtained from stakeholder consultations and from published documents. It is the professional judgment of the study team that this data will be sufficient to characterize the extent of labour and economy environmental and economic effects generated by the Project to support the environmental assessment.



5.11.3 Residual Effects Rating Criteria

A *significant residual environmental effect* on the economy is one where the Project induces adverse changes in regional employment and/or the regional economy of western New Brunswick (or the upper Saint John River valley).

A *significant residual environmental effect* on labour is one where the Project results in an adverse change in regional employment in the Upper Saint John River valley and/or the regional employment of western New Brunswick.

A *significant residual economic effect* for the forestry and agriculture components of Labour and Economy is one that affects the regional sector's ability and viability, such that processing facilities would close or curtail operation with a loss of employment, or modify commodity prices and or the producer's ability to access market.

5.11.4 Existing Conditions

5.11.4.1 Population

The Project is primarily located in New Brunswick's Carleton County and the southern portion of Victoria County. The 2001 population of Carleton County is 27,184. The major community in southern Victoria County is Perth-Andover with a population of 1,908. The area population has grown approximately 1% since the previous census in 1996. Table 5.11.1 provides a summary of the towns and villages within the Assessment Area.

Table 5.11.1 Communities and Carleton County Populations - 2001

Community	Population	Residential Dwellings
Bath	592	230
Bristol	719	295
Centreville	535	240
Florenceville	762	295
Hartland	902	345
Woodstock	5,195	2,165
Woodstock First Nation	250	90
Sub Total Community	8,958	3,660
Carleton County (total)	27,184	10,175
Perth-Andover	1,908	810

Source: Statistics Canada 2001 Census

The population of the Assessment Area is primarily located outside the towns and villages, reflecting its rural character and agriculture land use.



5.11.4.2 Labour Force

The 1996 labour force of the Region (the Enterprise Carleton Region, which includes most of Carleton County and the York County communities of Canterbury and Meductic) is 13,910 or 64% of the population fifteen years or older. The June 2003 unemployment rate for the Woodstock to Edmundston region was 9.8% compared to 10.6% for the Province and 7.7% for Canada (recent unemployment rates are only available for economic regions and major centres). The Carleton region has generally had one of the lowest unemployment rates in the Province. The most recent unemployment rate for Carleton County (census day 2001) was 8.6% versus the Provincial rate of 12.5%.

Table 5.11.2 summarizes the employment by major industry sectors for the Carleton region.

Table 5.11.2 Enterprise Carleton Region 1996 - Employment by Major Sector

Major Sectors and Industries	Employment by Sector	Share of Total Employment Carleton	Share of Total Employment Province
Manufacturing (food, clothing, wood products, equipment etc.)	2,480	17.8%	13.0%
Retail Trade	1,490	10.7%	12.7%
Health and Social Services	1,135	8.2%	10.7%
Hospitality and Other Services	1,600	11.5%	13.6%
Agriculture and Related	1,295	9.3%	2.4%
Transportation and Storage	1,055	7.6%	4.8%
Construction	855	6.1%	6.8%
Education Services	780	5.6%	7.4%
Government	660	4.7%	8.4%
Logging and Forestry	445	3.2%	2.1%
Other	2,115	15.2%	18.1%

Comparing the employment by industry sector to the Provincial figures illustrate the importance of manufacturing, agriculture, forestry, and transportation to this Region. Industrial sectors, such as construction, retail, and hospitality services that will supply labour and services to the Project, are also important to the Region.

The median income (population 15 years and over) for Carleton County is \$18,139 (2001 census) compared to the provincial average of \$18,257 and the Canadian average of \$22,120.

5.11.4.3 Tourism and Hospitality Sector

The Provincial government's inventory of tourism establishments identified 34 accommodation businesses (motels, hotels, bed and breakfasts) 6 campgrounds and 11 outfitters along both sides of the Saint John River Valley between Woodstock and Perth Andover. Other tourism related businesses include restaurants, various retail operations, numerous festivals, farmers markets, art galleries, golf



courses and museums. The major tourism attractions in the Upper Saint John River tourism region include the Hartland Covered Bridge and the Grand Falls Gorge.

The Saint John River valley is a major New Brunswick tourism route. The peak tourism season for this area is June through September. During this period, hotel/motel roofed accommodation occupancy rates are typically above Provincial averages, whereas they are generally lower during the remainder of the year.

Most visitors are traveling by road and are on a tour of Atlantic Canada when they pass through the region (average trip duration is 17.5 nights away from home). The major tourism markets (origin of tourists) are Ontario 40%, Quebec 22%, and the US 20%. Many visitors (52%) to New Brunswick are making their first visit. Many travelers have done research before they left home, but have not completely planned their trips. In other words, they have flexibility in terms of where and how long they stop along the way. Sixty-six percent had not made advanced reservations for accommodations (New Brunswick Department of Tourism and Parks 2001).

The area offers a range of attractions and activities (e.g., hiking, biking, hunting, fishing, boating, camping), but likely the biggest attraction is the scenic drive along the River. However, the Upper Saint John River Valley does not have a major attraction that makes the area a major tourist destination. Many attractions, hospitality facilities and communities rely on the pass through traffic making unplanned stops. For this reason, visibility from the highway, highway signage and visitor information centres are important factors in attracting visitors.

5.11.4.4 Regional Public Services

Health Services

The Perth-Andover to Woodstock area is part of New Brunswick's Health Region 3. The Region is served by local hospitals located in Bath, Perth Andover and Woodstock. Ambulance Services for the area are provided from Plaster Rock, Tobique, Perth-Andover, Florenceville and Hartland. The major health care facility for Health Region 3 is located in Fredericton.

Fire Fighting Services

Firefighting services for the Perth-Andover to Woodstock region are located in Florenceville, Bath, Glassville, Bristol, Hartland, Perth Andover, Centreville, Lakeville, Plaster Rock, Debec, Maliseet and Woodstock. These firefighting services cover both incorporated municipalities and local service districts. The local service districts that do not have firefighting service contract with neighboring jurisdictions to provide the service on a cost sharing basis.



Transportation and Traffic Network

The existing TCH from Perth-Andover to Woodstock is a two-lane primary arterial highway that extends through the region. It serves two purposes. It is a national highway that carries through traffic between eastern New Brunswick and the other Atlantic Provinces, Maine, and the rest of Canada. It also serves as a local highway and carries local traffic to and from the region, as well as "door-to-door" and farm traffic within the region. As such, the mix of traffic along this section of the existing TCH can be very hazardous. The rate of fatalities along the existing two-lane TCH is as much as five times that of the Provincial average fatality rate along four-lane divided highways, as the proposed TCH. Table 5.11.3 below presents a comparison of the historic levels of traffic accidents along the existing TCH versus Provincial four-lane divided highways (NBDOT 2002).

Table 5.11.3 Historic Average Accident Rates by Severity

Highway Segments	Accident Rate by Severity (Acc/100 MVK)*		
	Fatal	Injury	Property Damage Only
Perth-Andover to Florenceville	1.2	10.0	27.4
Florenceville to Woodstock	1.5	17.1	36.0
Four-lane divided highways in New Brunswick	0.3	9.9	24.9

*Accidents per 100 million vehicle-kilometres

Traffic volumes along the existing TCH range from 4,200 to 8,800 vehicles per day, with the highest volumes in the Woodstock area where local traffic is highest. Through traffic between Perth-Andover and Woodstock is in the range of 3,000 to 3,500 vehicles per day. The remaining traffic traveling to and from the region will use sections of both the existing TCH and the proposed TCH. Trucks currently make up 27% to 34% of the total traffic along the existing TCH. Most trucks, with the exception of local industry and delivery trucks, will divert to the proposed new TCH (NBDOT 2002).

Highway traffic conditions are classified into six levels of service (LOS) ranging from LOS A (excellent free flowing operating conditions) to LOS F (substantial delay and stop and go traffic conditions). At LOS D or worse conditions, improvements to the highway are warranted, and at LOS E the highway is operating at capacity. Presently the segment of the existing TCH from Perth-Andover to Florenceville is operating at a level of service (LOS) D and the segment from Florenceville to Woodstock at LOS E. Upon completion of the proposed TCH the traffic diversion will result in LOS A conditions on the proposed TCH, while the existing TCH segments from Perth-Andover to Florenceville and Florenceville to Woodstock will operate at LOS A and C, respectively (NBDOT 2002).

The diversion of the through traffic diversion from the existing TCH to the proposed TCH will result in improved safety and service levels along both highways.



5.11.4.5 Agriculture

Agriculture is a major factor in terms of both the landscape and economy through most of the area of the proposed TCH route. Over the last fifty years agriculture in Carleton and Victoria counties has grown to become the most important production area in the province (G. Maicher, DAFA, pers. comm. 2003).

In 2001, Carleton and Victoria counties accounted for over 52% of the provincial field crop (excluding grain and oilseed) operations. Nationally, New Brunswick is fourth in potato area planted and second in yield. Potatoes account for 25% of all farm cash receipts (\$104 million in 2001) in New Brunswick, with dairy ranked second at 17% (NB Potato Statistics Update, B. Ouellette, DAFA, documentation).

Statistics Canada's 2001 Census data reports 380 farms in Carleton County and 169 in Victoria County which combined represent over 21% of the provincial farm population. Twenty five per cent of New Brunswick farms with gross farm receipts of more than \$250,000 are in Carleton County.

Most of the agriculture production in Carleton and Victoria counties is on the west side of the Saint John River and is potato or potato related through crop rotation. The importance of this crop continues to increase and more land is being recovered, rejuvenated and placed into potato production. Between 1991 and 2001 there has been a 15% increase in potato production area (NB Potato Statistics Update, Benoit Ouellette, DAFA, documentation) partly from the conversion of forestland to agriculture.

The agriculture sector in Carleton and Victoria counties account for an estimated 80% of the provincial potato production, 85% of all the grain production, and 75% of all the beef production (stakeholder consultations, pers. comm. 2003).

Both potatoes and beef are highly dependent on transportation for low cost, given that they are low priced commodities, and for product freshness. Eighty percent of potatoes produced are exported or shipped to central Canada. New Brunswick beef is exported or transported to Guelph, Ontario for slaughter and processing. Any imported feed has a \$30/tonne transportation cost associated with it.

Potatoes going to the United States are subject to a series of inspections for such issues as crop infections and bio-terrorism under the Homeland Security Program and the Food and Drug Inspection Agency (FDA), which adds cost and time to the delivery and may affect freshness (P. MacDonald, Potatoes NB, pers. comm.).

Statistics Canada 2001 Census Consolidated Subdivisions (CCS) states that there are 126 farm operations in the Assessment Area representing 5% of the provincial farm population. These operations represent 12% of the Provincial field crop producers (potatoes) and 5% of the Provincial beef cattle producers.



As discussed in Section 5.8.4.4 Agriculture, farmland in the Assessment Area is among the most productive in the province. According to the Canada Land Inventory (CLI), 97% of the land in the Assessment Area is a CLI Class 4 or better and, according to Statistics Canada (2001 Census), farms in the Assessment Area are larger operations with 11 percent of farms having a land base greater than 453 ha compared to 9 percent in Carleton County and 3 percent provincially.

Agriculture and Labour

The consolidation of farms (combining several farms through acquisition or lease) has decreased the numbers of farmers but increased the size of farms substantially. It is not uncommon for several traditional farms to be combined into one larger parcel and for a farm to have several separate large parcels often many kilometers apart (Stakeholder consultations).

Farm consolidation and the resulting larger sophisticated highly mechanized farm operations require medium priced skilled labour during the different stages of production. Traditionally the peak demand is during the harvest. Operators have sought to diversify their business activities in part to provide year round employment to at least a portion of their labour force. The school year begins in mid-August with the Potato Break occurring during the harvest period in September. While mechanization has reduced the labour intensity of the harvest, there are periods of high demand for skilled and semi-skilled labour to supplement the regular labour force during harvest. This need is partly filled with a school-aged labour force and hence the need for the Potato Break.

The strong industrial (mostly agriculture based) sector draws part of its labour force from outside the population centres. This affects the availability and cost of local labour. Seventy five percent of Carleton County businesses are outside municipal boundaries and there is considerable commuting between communities (CRDC 1999). The agri-food industry (McCain Foods) is a major contributor to the economic profile supporting the manufacturing and transportation sectors. Carleton County has more truck-transport operators per capita than anywhere in Canada. Many potato producers have transport tractor-trailers or their own trucking business (G. Melanson, Enterprise Carleton Region, pers. comm. 2003).

5.11.4.6 Forestry Resources

The forest sector in Carleton and Victoria Counties directly employs over 1,000 people in logging, forest management and secondary processing (CRDC 1999).

The Carleton-Victoria Forests Products Marketing Board (CVFPMB) administers the marketing of the majority of the forest products harvested within the two counties, as well as the delivery of forest management services to private woodlot owners. The Annual Allowable Cut (AAC), harvest from



private woodlots in the two counties, represents approximately 314,000 m³, all species combined (NBDNRE 1995), from a forest land base of approximately 185,000 ha (NBDNRE 1989). Assuming an average of \$50 per m³, the value of logs and pulpwood delivered from private woodlots to mills this represents \$15.7 million of gross revenues per year to woodlot owners, logging and trucking businesses.

As a result of the proximity to United States and other New Brunswick forest products markets, competition for wood has resulted in higher stumpage values within the CVFPMB than the provincial average (Agfor Inc. 2003).

Approximately 1,300 hectares of forest lands are silviculturally treated annually within the CVFPMB area on private woodlots in the Carleton and Victoria counties (NBDNRE 2002b) valued at approximately \$750,000 to \$1,000,000 per year.

Christmas Trees

Approximately 175,000 Christmas trees are produced annually in the Assessment Area. With the majority being exported to the US and some as far as Mexico (A. Watson, pers comm.).

Maple Producers

Although there are several maple syrup producers in the region there are none identified within the proposed TCH alignment.

5.11.5 Environmental Effects Analysis

5.11.5.1 Project-VEC Interactions

Table 5.11.4 Project Activity – Environmental Effects Interaction Matrix – Labour and Economy

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>LABOUR AND ECONOMY</u>				
Project Activities and Physical Works (see Table 4.1 for list of specific activities and works)	Potential Environmental Effects			
	Change in Employment	Change in Commercial Employment and GDP	Change in Agriculture	Change in Forest Resources
Construction				
Site Preparation	✓	✓	✓	✓
Roadbed Preparation	✓			
Surfacing and Finishing	✓			
Watercourse Crossings Structures	✓			
Ancillary Structures and Facilities Construction	✓		✓	✓



Table 5.11.4 Project Activity – Environmental Effects Interaction Matrix – Labour and Economy

Potential Interactions Between Project Activities and Environmental Effects Valued Environmental Component: <u>LABOUR AND ECONOMY</u>				
Project Activities and Physical Works (see Table 4.1 for list of specific activities and works)	Potential Environmental Effects			
	Change in Employment	Change in Commercial Employment and GDP	Change in Agriculture	Change in Forest Resources
Operation				
Winter Safety				
Proposed TCH Presence	✓	✓		
Maintenance				
Proposed TCH Maintenance	✓	✓		
Vegetation and Wildlife Management				
Accidents, Malfunctions and Unplanned Events				
Construction			✓	✓
Operation		✓	✓	✓
Maintenance			✓	✓
Other Planned Development	✓	✓	✓	✓

5.11.5.1.1 Construction

The interaction of the environmental effects of the construction activities and physical works of the Project with the Labour and Economy VEC is summarized in Table 5.11.4 and described below.

Employment

The Project will inject an estimated \$200 million of net construction expenditures and create construction labour employment throughout all phases of the four-year construction period, which will affect employment levels locally and throughout the Province. This will result in positive environmental and economic effects.

Commercial Activity

All of the Project construction activities are expected to result in an increase in the requirements for commercial accommodations, meals, other supplies and services. Local community businesses will benefit from the sale of goods and services to construction contractors and workers during all construction phases of the Project. This will result in positive economic effects.



Forest Resources

As presented in section 5.8.5.1.1, all of the environmental effects to the forest resource will occur or be initiated during the site preparation (clearing) portion of the Construction phase. The environmental effects centre around the removal of forest landbase resulting in a loss of production to the landowner and forest cover in general. During the site preparation stage of construction the following adverse environmental effects to the forest resources may occur.

As discussed in Section 5.8 Land Use, the proposed TCH's construction area, 7365 ha of forest land will be cleared, including 340 ha of young and 186 ha of immature forest. The clearing will generate 33,000 m³ of softwood and 42,500 m³ of hardwood for the commercial forest products market. This represents about 10-14% of the AAC for private woodlots in Carleton and Victoria counties. Portions of woodlots will be severed, possibly resulting in economically in-operable remnant parcels. The loss of forest land represents substantially less than one percent of the forest land base in Victoria and Carleton counties.

During construction, competition will exist between forestry contractors and road building contractors for local heavy equipment and truck operators.

Agriculture

As discussed in Section 5.8 Land Use, all of the environmental effects to the agriculture resource will occur or be initiated during the site preparation (clearing) of the construction phase. The environmental effects centre around the removal of and/or access to agriculture land resulting in a loss production to the landowner, during the site preparation stage of construction. As discussed in Section 5.8 Land Use, the proposed TCH's construction area will remove 223 ha of agricultural land, recently developed agriculture land or infrastructure from production.

As discussed in Section 5.8 Land Use, the proposed TCH's construction will sever farm operations resulting in transportation and access routes to agriculture land being disrupted or interfered with during construction.

Competition will exist between farm operations and road building contractors for heavy equipment and truck operators and general labour. This will be particularly evident during potato harvest (last two weeks of September) when there is an increased demand for medium cost semi- and skilled labour. The longer construction season and generally better wages will be factors.



Ancillary Structures and Facilities Construction

The same adverse environmental effects will occur during the construction of any Ancillary Structures and Facilities Construction, however these sites have not been identified at the time of report preparation therefore the magnitude of the individual adverse environmental effects will vary. It must be noted that many of the ancillary facilities will be temporary and thus some of these areas (such as temporary work areas) may be returned to use by either the forestry or agricultural industry sectors.

5.11.5.1.2 Operation

The interaction of the environmental effects of the Project operation with the Labour and Economy VEC is summarized in Table 5.11.4, and described below.

Employment

The presence of the proposed TCH will interact with employment within the region due to the potential redistribution of economic activity. The presence of the proposed TCH may create some employment and business losses along the existing TCH, but some, or all, of the employment losses along the existing TCH may be offset by the gains in employment from commercial activity generated adjacent to the proposed TCH alignment, primarily at interchanges.

Commercial Activity

By-Passed Businesses

The proposed TCH will primarily be new alignment, which will result in diversion of most long distance traffic that passes through the region from the existing TCH to the proposed TCH. The presence of the proposed TCH will affect traffic on the existing TCH. The composition of traffic on the existing TCH will shift from its current mix of local and through traffic to a traffic stream largely composed of local residents and businesses. This is expected to affect commercial activity of the businesses that primarily cater to the highway traffic, such as restaurants, accommodations and service stations. The existing conditions of Section 5.8 Land Use identifies the existing types of commercial businesses along the existing TCH, along with other tourism related businesses located within the Project boundaries.

Tourism Sector

Most tourists and visitors pass Perth-Andover to Woodstock through the area on their way to major destinations, such as the Bay of Fundy, PEI or Halifax. Decisions by these pass-through tourists to visit Saint John River Valley attractions, or find accommodations and services, are often made on the spur of



the moment as they drive along. Many attractions and facilities, such as the Hartland Covered Bridge depend on visibility and easy access to attract a portion of their tourism market. The presence of the proposed TCH will divert some traffic from the existing TCH to the proposed TCH, which will reduce the visibility and accessibility of some of the area's tourist attractions.

New TCH Commercial Development

The presence of the proposed TCH will attract some new commercial development that will benefit from good access to the proposed TCH, primarily at new interchanges, as well as more efficient highway access to domestic and trans-border markets. New commercial activity is expected to develop to serve the proposed TCH users including restaurants, accommodations, retail outlets and service stations. These highway user services are expected to take place at or near the identified interchanges, such as the development currently taking place at the Perth-Andover interchange.

Other Businesses

The presence of the proposed TCH will provide many businesses within the region that serve external area markets and/or receive product from external sources an improved and more efficient highway to conduct their business.

Forest Resources

Most of the environmental and economic effects to the forest resource will occur or be initiated during the site preparation (clearing) of the construction phase due to the removal of forest landbase. Although the environmental effects of the loss of the currently forested land or forest harvesting will continue in perpetuity, this effect is considered in the compensation for any loss to landowners and therefore the environmental effects of this loss are only considered in the construction phase of the Project. As discussed in Section 5.8 Land Use, operating costs may increase for woodlot owners who have will have severances because of having to transport forest products longer distances or having to float (move) equipment to separate work locations.

During the operational period positive economic effects to the forest sector may arise from improved transportation of wood products from the landowner to the processing facility (mill) and from the facility to market (D. Crabbe, pers. comm. 2003). The Assessment Area's proximity to the US results in significant volumes of both roundwood and processed wood moving across the Maine-New Brunswick border.



Agriculture Resources

Most of the environmental effects to the agriculture resource will occur or be initiated during the site preparation of the construction phase. Although the environmental effects of the loss of land currently being used for agricultural purposes will continue in perpetuity, this effect is considered in the compensation for any loss to landowners and therefore the economic effects of this loss are only considered in the construction phase of the Project. The economic effects centre around the removal of and/or access to agriculture land resulting in a loss production to the landowner.

5.11.5.1.3 Maintenance

The interaction of the maintenance activities of the Project with the Labour and Economy VEC is summarized in Table 5.11.4, and described below.

Employment

The proposed 70.7 kms of four-lane highway will be a net addition to the Provincial highway network. This will require additional annual expenditures on maintenance equipment, materials, services and labour that will continue in perpetuity. The Province will require additional employees to conduct ordinary ongoing summer and winter maintenance, and periodic resurfacing activities, beginning immediately upon the opening of the proposed TCH operations.

Commercial Activity

Businesses that supply materials, equipment and services for regular annual highway maintenance activities, such as fuel, sand and salt, asphalt patching, and any out-sourced services will be positively affected by the expanded highway network. This activity will recur in perpetuity.

Periodic highway resurfacing or reconstruction (approximately 15-year cycles) will generate commercial activity among paving contractors.

5.11.5.1.4 Accidents, Malfunctions and Unplanned Events

The interaction of the accidents, malfunction and unplanned events along the proposed TCH with the Labour and Economy VEC is summarized in Table 5.11.4, and described below.



Commercial Activity

Accidents, malfunctions and unplanned events, such as vehicle accidents, could result in short term business interruptions.

Forest Resources

As discussed in Section 5.8 Land Use, incremental harvesting is an unplanned event that is in-progress since approximately 2001 and therefore difficult to quantify at this time. Incremental harvesting will remove more forest cover than required for the Project.

Agriculture

Accidents, malfunctions and unplanned events (e.g., fire, hazardous material spill) could results in interruptions to agriculture.

5.11.5.2 Environmental Effects Analysis and Mitigation

5.11.5.2.1 Construction

The potential environmental (and economic) effects of construction on Labour and Economy are characterized in Table 5.11.5. Potential mitigation measures during Project construction, are also provided. The following provides a detailed discussion of these potential effects.

**Table 5.11.5 Environmental Effects Assessment Matrix for Labour and Economy
(Construction)**

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LABOUR AND ECONOMY</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio- Cultural and Economic Context
Site Preparation	Change in Commercial Activity (A) (P)	Purchase of commercial properties in footprint will allow business to relocate	1	1	5/1	R	2
	Change in Employment (P)	Preference given to the use of local and Provincial labour	2	2	5/1	R	2



**Table 5.11.5 Environmental Effects Assessment Matrix for Labour and Economy
(Construction)**

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LABOUR AND ECONOMY</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
	Change in Agriculture (Land taken out of production) (A)	- Land Acquisition: Open and early communication with landowners - Time (as construction schedule permits) for landowner to exercise mitigating options - Compensation for market value of land - Provision of access to severed properties, where necessary	2	2	5/6	1	2
	Change in Agriculture (Operations) (A)	- Accommodation to allow agriculture operations access to adjoining or severed lands during construction - Notice to adjust crop rotations to reduce access conflict and to reduce potential for loss of revenue - Scheduling construction around harvesting, where possible	2	1	3/1 or 2	R	2
	Change Forest Resources (Land Taken Out of Production) (A)	- Land Acquisition: Open and early communications with landowners - Time (as construction schedule permits) for landowner to exercise mitigating options - Compensation for market value of land - Provision of access to severed properties, where necessary	2	2	2/1	1	2
	Change in Forest Operations (A)	Reasonable accommodations made to allow forestry operations access to adjoining lands during construction	2	2	3/1	R	1
Surfacing and Finishing	Change in Commercial Activity (P)	No enhancement measures necessary	1	1	5/1	R	2
	Change in Employment (A)	None recommended	2	2	5/1	R	2
Watercourse Crossings Structures	Change in Commercial Activity (P)	No enhancement measures necessary	1	1	5/1	R	2
	Change in Employment (P)	None recommended	2	2	5/1	R	2



**Table 5.11.5 Environmental Effects Assessment Matrix for Labour and Economy
(Construction)**

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LABOUR AND ECONOMY</u> Phase: <u>Construction</u>							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Ancillary Structures and Facilities Construction	Change in Commercial Activity (P)	No enhancement measures necessary	1	1	5/1	R	2
	Change in Employment (P)	None recommended	2	2	5/1	R	2
	Change in Forest Resources (Land Taken Out of Production) (A)	- Land Acquisition: Open and early communications with landowners - Time (as construction schedule permits) for landowner to exercise mitigating options - Compensation for market value of land - Provision of access to severed properties - Reasonable accommodations made to allow forestry operations access to adjoining lands during construction	2	1	3/1	I	2
	Change in Forest Resources (Operations) (A)	Reasonable accommodations made to allow forestry operations access to adjoining lands during construction	2	1	4/1	R	2
	Change in Agriculture (Land Taken Out of Production) (A)	- Land Acquisition: Open and early communications with landowners - Time (as construction schedule permits) for landowner to exercise mitigating options - Compensation for market value of land - Provision of access to severed properties, where necessary	2	2	5/6	I	2
	Change in Agriculture (Operations) (A)	- Accommodation to allow agriculture operations access to adjoining or severed lands during construction - Inform farmers of construction schedule - Scheduling construction around harvesting, where possible	2	1	3/2	R	2



**Table 5.11.5 Environmental Effects Assessment Matrix for Labour and Economy
(Construction)**

Environmental Effects Assessment Matrix Valued Environmental Component: <u>LABOUR AND ECONOMY</u> Phase: <u>Construction</u>						
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility Ecological/Socio-Cultural and Economic Context
Key: Magnitude: 1 = Low: e.g., employment and business opportunities are affected for eighteen months. 2 = Medium: e.g., employment and business opportunities affected for more than eighteen months but less than the life of the Project. 3 = High: e.g., employment and business opportunities affected for longer than the life of the Project or irreversibly. Geographic Extent: 1 = < 1 km² 2 = 1-10 km² 3 = 11-100 km² 4 = 101 - 1,000 km² 5 = 1,001 - 10,000 km² 6 = >10,000 km² Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Reversibility: R = Reversible I = Irreversible						

Employment

The construction phase of the Project will inject an estimated \$200 million of net construction expenditures during the four-year period and will have a positive economic effect locally and throughout the Province. It will result in \$188 million of spin-off economic activity within the Province, a net contribution to the Provincial Gross Domestic Product (GDP).

A portion of the direct and indirect expenditures will be spent within the local region for the purchase of materials, equipment and services, which will spin-off employment in other sectors. The Carleton-Victoria region has well-established trucking and prominent equipment production and sales industries. It should be well positioned to provide trucking and other construction equipment services. The Province is also well endowed with highway construction contractors, represented by the New Brunswick Road Builders Association, that are prepared for the proposed TCH construction opportunity.

The Project will create about 1,750 person-years of employment and generate approximately \$50 million of direct labour income. Some of this employment will be drawn from the local labour force, while most of the rest will be supplied from elsewhere within the Province. The labour income will produce another \$18 million of spin-off expenditures. The indirect spin-off labour generated by the direct Project expenditures and labour income will result in just under 1,700 person-years of additional employment in other economic sectors distributed throughout the Provincial economy.



The positive effects of the Project on employment during all construction phases will occur over a planned four-year period. The economic effects of highway construction are generally realized immediately, and end within a year of Project completion. Due to the magnitude and intensity of the construction Project (over 70.7 kms of four-lane highway to be built over four years) and the present high levels of employment of the region's labour force, it is highly likely that construction contractors and labour will be brought in from outside of the local area.

Project construction will increase the demand for skilled and semi-skilled labour at existing businesses in the area. Competition between farm operations and road building contractors for heavy equipment and truck operators and general labour is expected. This will be particularly evident during potato harvest (last two weeks of September) when there is an increased demand for medium cost semi- and skilled labour. The longer construction season and generally better wages will be factors. The mitigation is through scheduling. During the last two weeks of September, medium cost skilled and semi-skilled labour are needed to harvest potatoes. Scheduling construction activities to accommodate the temporary demand for labour and the increased local traffic may be useful.

The potential economic effects of the Project construction on employment are generally and overall very positive at the local regional and Provincial levels. To enhance these positive economic effects the Province can stipulate the Provincial content requirements in the contracts, as was done for the Fredericton to Moncton Highway Project.

Commercial Activity

The Project construction, with an estimated cost of \$200 million over four years, is expected to translate into substantial benefits to the existing businesses in the area, including those on the existing TCH. Housing and feeding the workforce will translate into business for motels, hotels, restaurants, caterers and retail outlets over the life of the Project. Other businesses will benefit through the supply of other goods and services such as construction companies, construction materials, suppliers, heavy equipment companies (supply and service), security, engineering services and others.

All of the Project construction activities are expected to result in an increase in the requirements for commercial accommodations, meals, other supplies and services. Local community businesses will benefit from the sale of goods and services to construction contractors and workers during all construction phases of the Project. Although actual formulas to ascribe construction Project economic effects on local communities are not available, it is widely known that large construction projects provide an economic boost to the local areas. For example, highway projects consume local gravel and/or quarried stone, and hire local skilled trades workers and casual labourers, as direct input to the projects. In addition, construction project workers from outside the locale generate additional revenue to local service industry businesses, such as restaurants, service stations, convenience stores, hotels, etc.



These economic effects will take place along the entire length of the Project, particularly in the larger communities where most of these businesses are located. These positive incremental commercial economic effects of the Project will also be received by some of the most vulnerable businesses, those accommodation, restaurant, and service station businesses along the existing TCH.

The extent and location of the positive commercial economic effects will not be fully known until the construction is under way. However, of the estimated \$200 million of direct expenditures on this Project, approximately \$45 million will be spent on construction employment. In addition, the direct expenditures will spin-off over \$167 million of indirect expenditure activity within the Province. Although there is no means to quantify the monetary value retained within the local area, highway construction projects are known to spin-off considerable amounts of local economic activity. These positive commercial activity effects will occur throughout all the construction phases.

The Project is expected to result in a number of economic effects on the commercial activity within the area during the construction phases. Project construction will increase the demand for goods and services from some existing businesses in the area, such as restaurants, accommodations, retail outlets and service stations located along the existing TCH and local communities.

Three businesses within the proposed TCH RoW that were identified in Section 5.8 Land Use have already been relocated. These three businesses within the proposed TCH RoW represent a small portion of the commercial sector in the area and the effect on the regional economy was not significant.

Overall, with planned mitigation, the environmental and economic effects of construction on Labour and Economy (commercial activity) are considered positive.

Forest Resources

As discussed in sections 5.8, most of the environmental effects to the forest resource will occur or be initiated during the site preparation. The potential economic effects centre around the removal of and/or access to forest landbase during construction resulting in a loss of production to the landowner and forest cover.

As discussed in Section 5.8 Land Use, the proposed TCH's construction area, 7365 ha of forest land, which represents 0.93% of the forest within the Assessment Area and 0.4% of the CVFPMB wood supply area plus any ancillary features will be cleared. Portions of woodlots may be severed, which may result in economically in-operable remnant parcels; approximately 490 ha of forest lands will be considered remnants, representing 0.62% of the Assessment Area and 0.3% of the CVFPMB's forest lands, including 340 ha of young and 186 ha of immature forest. Landowners will be compensated for



this loss. This amount of young forest is reflective of the forest condition within the Assessment Area and wood supply area.

Harvesting of some of this volume has been in progress since 2001 and is expected to continue until 2004/2005. According to the CVFPMB, these annualized volumes spread-out over three or four years are within normal fluctuations and are not expected to disrupt the local private woodlot operators' access to markets.

The primary mitigation for productive forest land loss is through compensation of landowners for both the lands acquired, used or otherwise affected by the proposed TCH at market value, and the forest resource on those lands. Landowners will be clearly and consistently informed as to their rights, options and the methods of valuation as they pertain to the New Brunswick *Expropriation Act* and NBDOT's methods of valuation and negotiation.

Most woodlot owners are also facing a business decision that is imposed on them by the Project. There are commonly situations whereby landowners may elect to harvest or arrange to have that portion of the property harvested rather than receive compensation for standing timber to be cleared. As allowed by the construction schedule, NBDOT will allow time for the landowner to organize and implement clearing options in a timely manner consistent with existing operations.

Access to Forest Lands

Not all land will be acquired by NBDOT. There will be properties that will be severed and the construction of the proposed TCH and access roads may take two to three years to complete. As allowed by the construction schedule, NBDOT will provide on-going forestry operations with safe access across the RoW at certain periods of the year, when required.

Summary for Forest Resources

Overall, in consideration of the planned mitigation, the potential environmental and economic effects of construction on Labour and Economy (for forest resources) are considered not significant.

Agriculture Resources

As discussed in sections 5.8, most of the environmental effects to the agriculture resource will occur or be initiated during the construction phase. The economic effects centre around the removal of and/or access to agriculture land resulting in a loss of productive capacity and production by the landowner. Because some of the environmental effects will continue beyond the construction phase, the mitigation while initiated during construction, should reflect other Phases of the Project. The primary mitigation is



through landowner compensation at market value for the lands acquired, used or otherwise affected by the proposed TCH.

As discussed in Section 5.8 Land Use, the proposed TCH's construction area will remove 223 ha of agricultural land, recently developed agriculture land or infrastructure from production (0.3% of the annual provincial potato production area).

Landowners will be clearly and consistently informed as to their rights, options and the methods of valuation and negotiation as they pertain to the New Brunswick *Expropriation Act* and NBDOT's compensation methods.

Farms are business/economic interests with land being the source of productive capacity. Those farm operations affected by the Project are also facing a business decision that is imposed on them by the proposed TCH. There are commonly situations whereby farm operators may wish to make adjustments to their operations. As the construction schedule permits, time will allow the landowner to organize and implement the activities in a timely manner consistent with existing operations. NBDOT will work with landowners to plan and accommodate those changes.

Access will be provided to severed properties where required and as practical to allow agriculture to continue.

Overall, with planned mitigation, the potential environmental and economic effects of construction on Labour and Economy (Agriculture Resources) are considered not significant.

5.11.5.2.2 Operation

The potential environmental and economic effects of the Project operation on Labour and Economy are characterized in Table 5.11.6. Potential mitigation measures during Project operation, are also provided. The following provides a detailed discussion of these potential effects.



Table 5.11.6 Environmental Effects Assessment Matrix for Labour and Economy (Operation)

Environmental Effects Assessment Matrix Valued Environmental Component: LABOUR AND ECONOMY Phase: Operation							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Presence	Change in Commercial Activity (A)	- Increased marketing efforts by Provincial and regional economic development organizations to assist existing business to respond to new traffic patterns and opportunities - Highway signage	1	1	5/6	R-1	2
	Change in Employment (A) (P)	Employment insurance and Placement assistance programs	1	2	2/2	R	2
Key: Magnitude: 1 = Low: e.g., employment and business opportunities are affected for eighteen months. 2 = Medium: e.g., employment and business opportunities affected for more than eighteen months but less than the life of the Project. 3 = High: e.g., employment and business opportunities affected for longer than the life of the Project or irreversibly. Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Employment

Experience elsewhere has shown that to a large extent economic activity adversely affected along an existing highway will be transferred to the new highway. This activity may be in a different form and location, but the net losses, if any, in employment or commercial activity are generally minor, especially in the context of the overall regional or Provincial economies. While the personal hardships that may result during the business transfer transition (i.e., employees transferred to another business development), should not be overlooked or downplayed, in economic evaluation terms, the redistribution of employment and economic activity is not viewed negatively. Any net job losses would be supported and mitigated under existing federal and provincial social "safety net" programs, such as Employment Insurance. Indirectly, improved road service may induce other businesses to establish or grow due to improved market/transportation access. These positive economic effects may be difficult to



quantify but are expected to occur and would tend to offset any potential adverse economic effect at a regional scale.

Commercial Activity

By-Passed Businesses and Tourism

A comprehensive study in 1999 by the Wisconsin Department of Transportation concluded that the "...wide range of highway by-pass studies carried out around the country provide a generally consistent story. They indicate that highway by-passes are seldom either devastating or the savior of a community business district. The locational shift in traffic can cause some existing businesses to turn over or relocate, but net economic impacts on the broader community are usually relatively small (positive or negative). Communities and business districts that have a strong identity as a destination for visitors or for local shoppers are the ones that are most likely to be strengthened due to the reduction in traffic delays through their centres. However, there is also a broad perception that adequate signage to the by-passed business centre is an important need (and concern) for ensuring its continued success."

Locally, anecdotal evidence from the recently completed Fredericton to Moncton segment of the TCH would seem to support these findings. The City of Fredericton reported last year that tourism figures were up, that being in the face of the expected losses following opening of the new TCH segment that by-passes the City. The Town of Oromocto, previously on the opposite side of the Saint John River from the former TCH, is now well exposed and accessed to the new TCH. It has undergone a commercial boom adjacent to its interchanges, since opening of the highway.

On the other hand, businesses located along the former TCH alignment, dependent on highway traffic business, have not fared as well, and some closures have already taken place. Other businesses, such as service stations have adapted by relocating to sites alongside the new highway alignment, (e.g., the new service station/restaurants at Salisbury and Nevers Road interchanges on the Fredericton to Moncton TCH).

In this context, businesses located directly along the existing TCH between Perth-Andover and Woodstock that have depended on the traveler market are apt to be vulnerable to potential business losses and possible failure. However, the Saint John River valley, along which the existing TCH follows, is a beautiful and significant tourist route of the Province. The reduction in overall traffic may improve its tourist attraction, and with proper signage and promotion may offset some of the potential off-season business losses.

Traffic diversion from the existing TCH to the proposed TCH will result in loss of market to some businesses located on the existing TCH, such as restaurants, accommodations, retail outlets and service



stations. The diversion of heavy trucks and through moving by-pass traffic from the existing TCH could enhance the accessibility and attractiveness of the existing TCH and the Upper Saint John River Tourism region to seasonal; tourists travelling to the area. Through traffic diversion from the existing TCH to the proposed TCH is expected to result in much improved access and suitability to the movement of agricultural equipment on the existing TCH.

The extent of the adverse economic effects of the presence of the proposed TCH on the businesses on or adjacent to the existing TCH will depend on the amount of traffic that is diverted to the proposed TCH, the ability of the establishments to market themselves to the traffic using the proposed TCH, and the reliance of various businesses on the highway traffic versus the local market. Businesses that have a small portion of their business servicing local markets (*i.e.*, not located in or near one of the major communities) are likely to be affected more than those whose business serves a local market as well.

Local traffic and tourists visiting the area will continue to use the existing TCH and require hospitality and other services. The Provincial and local tourism officials are working together to develop and promote regional attractions. These efforts may result in increased visitations to the Upper Saint John River valley region that could replace some or all the lost pass-by traffic tourism market. However, at this point the degree of success that these market development initiatives is not known.

There are numerous businesses that are located on the existing TCH because they require access to the primary highway system. They include a number of trucking companies and manufacturers that have no or very little reliance on the passing highway traffic. However, they need access to the highway system to conduct their business. The existing TCH will continue to provide their businesses access to the proposed TCH interchanges, so there should be little or no economic effect on these companies.

Suggested mitigation measures to address the loss of business for the highway-oriented businesses include the provision of highway signage, increased marketing efforts at the visitor information centres and more advanced marketing/information dissemination to reach Atlantic Canada visitors before they leave home. Regional and Provincial tourism/economic development officials are aware of the implications of the TCH upgrading in respect to potential tourism losses, and are placing greater effort on the identification and marketing of the attractions that will make the Saint John River Valley a destination. The objective of these efforts will be to develop attractions that will result in getting the visitors off the proposed TCH to travel along the more scenic existing TCH route to visit the region's attractions and communities. In support of these efforts, for example, the location of an interchange and connecting road to Hartland was selected to provide good access to bypassed businesses and tourist attractions (*e.g.*, covered bridge). Other interchanges along the Project have been selected in consideration of other community, business and tourism access issues.



The potential to lose tourist/visitor traffic will exist for any community or facility that will be further from the proposed TCH, or have reduced access. This includes a number of hotels, restaurants, campgrounds and attractions such as the Hartland covered bridge. The future success of these attractions and commercial establishments can be enhanced through the development of the Saint John River Valley region as a distinct tourism attraction, to offset the loss of direct access and visibility from the proposed TCH.

The question of whether transportation infrastructure is a driver of economic productivity, or rather a derived demand of other economic drivers has been a long standing topic of debate within the transportation industry. However, there is widespread agreement that productivity gains are correlated with highway infrastructure improvements, and that they are important. The level of service improvements of the proposed TCH will enhance the productivity of commercial and industrial sectors that are dependent on the long haul movement of production inputs and their output production to markets outside of the region.

Recent works have established methods to measure the extent of productivity gains associated with highway investments. For example, according to the Hickling's Lewis Brod report: *Highway User Benefit Analysis of the National Highway System*, prepared for the Transportation Association of Canada in 1998 (TAC 1998), substantial additional productivity benefits can be attained by the transportation industry and freight shippers and receivers from a highway improvement project. Productivity gains would benefit regional industry through reduced transport time and costs, increased average truck payloads, reduced inventory costs, reduced insurance claims and premiums, and improved competitiveness in downstream markets. No mitigation or enhancement measures will be necessary for these positive economic effects.

Overall, with planned mitigation and some positive outcomes including enhanced transportation efficiency afforded by the Project, the potential environmental and economic effects of Project operation on Labour and Economy (commercial activity) are considered not significant.

5.11.5.2.3 Maintenance

The nature of environmental and economic effects on Labour and Economy that may occur during maintenance activities, and potential mitigation measures to address any adverse effects are summarized in Table 5.11.7.



Table 5.11.7 Environmental Effects Assessment Matrix for Labour and Economy (Maintenance)

Environmental Effects Assessment Matrix Valued Environmental Component: LABOUR AND ECONOMY Phase: Maintenance							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Proposed TCH Presence	Change in Commercial Activity (A)	• Signing, detours, temporary access measures	1	2	1/2	R	2
	Change in Employment (P)	• None recommended	1	2	5/2	R	2
Key: Magnitude: 1 = Low: e.g., employment and business opportunities are affected for eighteen months. 2 = Medium: e.g., employment and business opportunities affected for more than eighteen months but less than the life of the Project. 3 = High: e.g., employment and business opportunities affected for longer than the life of the Project or irreversibly. Geographic Extent: 1 = < 1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = < 1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = < 11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							

Employment

Average annual maintenance expenditures for the proposed TCH will exceed \$2 million. Over a 20-year period this will result in 325 person-years of direct maintenance labour employment, which will spin-off another 315 person-years of indirect employment in other sectors. Highway maintenance activities are generally conducted by local labourers.

The net gains in annual maintenance labour will represent a net gain in employment within the local/regional and Provincial economies. The net employment will be permanent and largely within the public sector (i.e., jobs with NBDOT), and located at local District Offices and Maintenance Depots, unless contracted out to the private sector. There will be no need for enhancement or mitigation measures.

Major resurfacing and/or reconstruction maintenance activities will occur infrequently (i.e., approximately every 15 years) and could result in business disruptions. The potential delays and changes in traffic patterns are expected to be minor due to normal mitigation measures. These would



include providing temporary access to affected businesses, scheduling to avoid peak seasons and times of day, keeping the highway open by working on one lane at a time, temporary signing and flagging procedures, adherence to EPP and health and safety legislation, and providing public information and alternative routes.

Overall, with planned mitigation the potential environmental and economic effects of Project maintenance on Labour and Economy are considered positive.

5.11.5.2.4 Accidents, Malfunctions and Unplanned Events

The environmental and economic effects on Labour and the Economy that may occur as a result of accidents, malfunctions and unplanned events, and potential measures to mitigate adverse effects, are summarized in Table 5.11.8, and discussed below.

Table 5.11.8 Environmental Effects Assessment Matrix for Labour and Economy (Accidents, Malfunctions, and Unplanned Events)

Environmental Effects Assessment Matrix Valued Environmental Component: LABOUR AND ECONOMY Phase: Accidents, Malfunctions and Unplanned Events							
Project Activity (See Table 4.1 for list of specific activities and works)	Potential Environmental Effects	Mitigation	Magnitude	Geographic Extent	Duration/Frequency	Reversibility	Ecological/Socio-Cultural and Economic Context
Construction	Change in Forest Resources (A) Incremental Timber Harvesting)	- Communication with landowners well in advance - Advise landowners that survey lines may change	2	2	4/1	R	2
Operation	Change in Commercial Activity (A)	Review emergency response services and plan	1	1	5/1	R	2
Key: Magnitude: 1 = Low: e.g., employment and business opportunities are affected for eighteen months. 2 = Medium: e.g., employment and business opportunities affected for more than eighteen months but less than the life of the Project. 3 = High: e.g., employment and business opportunities affected for longer than the life of the Project or irreversibly. Geographic Extent: 1 = <1 km ² 2 = 1-10 km ² 3 = 11-100 km ² 4 = 101 - 1,000 km ² 5 = 1,001 - 10,000 km ² 6 = >10,000 km ² Duration: 1 = <1 month 2 = 1 - 12 months 3 = 13 - 36 months 4 = 37 - 72 months 5 = >72 months Frequency: 1 = <11 events/year 2 = 11 - 50 events/year 3 = 51 - 100 events/year 4 = 101 - 200 events/year 5 = >200 events/year 6 = continuous Reversibility: R = Reversible I = Irreversible Ecological/Socio-cultural and Economic Context: 1 = Relatively pristine area or area not adversely affected by human activity. 2 = Evidence of adverse environmental effects. N/A = Not Applicable (A) = adverse (P) = positive							



Accidents, malfunctions and unplanned events are expected to be less of a concern with the proposed TCH due to its greater capacity, controlled access, reduction in local and total traffic, and other safety features implicit in its design. As well, the commercial activity will not be directly adjacent and accessed to the proposed TCH, as is the case with the existing TCH. The main mitigation measure to avoid or reduce accidents, malfunctions and unplanned events is the safety elements of the new four-lane divided access-controlled design of the proposed TCH and related structures and facilities. Mitigation measures aimed at minimizing the consequences of accidents, malfunctions and unplanned events are the emergency response measures established to address the range of events. The improved traffic flows to be experienced along the proposed TCH will enhance emergency response measures.

Timber harvesting incremental to the Proposed TCH clearing is an unplanned event already in progress (Section 5.8.5.2.4). NBDOT should inform landowners well in advance with clear compensation considerations (including potential for realignment) and options to minimize or prevent incremental harvesting.

Overall, based on the planned mitigation, the potential environmental and economic effects of Project accidents, malfunctions and unplanned events are considered not significant.

5.11.5.3 Determination of Significance

Based on the consideration of the environmental and economic effects of the individual activities required to construct the proposed TCH, the proposed mitigation and the residual effects significance criteria, the residual effects on Labour and Economy (agriculture and forestry) by the construction activities of the proposed TCH are considered not significant.

The residual environmental and economic effects of the Project on Labour and Economy for all other sections are also considered not significant for all phases assessed. The proposed TCH may result in the closure of some commercial businesses along the existing TCH. This is particularly a concern for businesses with small or non-existent local markets. However, these closures will be offset by new commercial development. The overall sentiment of the existing business community and civic leaders is that the Project will have major benefits in terms of improved transportation for resident and businesses and will lead to new private sector investment.



Table 5.11.9 Residual Environmental Effects Summary Matrix for Labour and Economy

Residual Environmental Effects Summary Matrix Valued Environmental Component: LABOUR AND ECONOMY				
Phase	Residual Environmental Effects Rating*	Level of Confidence	Likelihood	
			Probability of Occurrence	Scientific Certainty
Construction	NS	3	1	3
Operation	NS	3	1	3
Maintenance	NS	3	1	3
Accidents, Malfunctions and Unplanned Events	NS	3	1	3
Project Overall	NS	3	1	3
Key Residual Environmental Effect Rating: S = Significant Adverse Environmental Effect NS = Not-significant Adverse Environmental Effect P = Positive Environmental Effect Level of Confidence 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence Probability of Occurrence: based on professional judgement 1 = Low Probability of Occurrence 2 = Medium Probability of Occurrence 3 = High Probability of Occurrence Scientific Certainty: based on scientific information and statistical analysis or professional judgement 1 = Low Level of Confidence 2 = Medium Level of Confidence 3 = High Level of Confidence N/A = Not Applicable *As determined in consideration of established residual environmental effects rating criteria.				

5.11.6 Monitoring and Follow-up

No monitoring or follow-up is recommended. Should Project-related issues be identified in the Labour and Economy sector, NBDOT should follow-up on an issue by issue basis, where appropriate.



5.12 Effects of the Environment on the Project

The definition of an environmental effect under Section 2(1) of the *CEAA* includes any change to the project that may be caused by the environment. The requirement to evaluate this aspect of environmental effects is often overlooked and the guidance documentation of the CEA Agency does not address specifically how the assessment is to be done. The Guidelines (Appendix A) require that environmental hazards potentially affecting the construction and operation phases of the Project be described, such as erosion, wind, floods, severe precipitation events, land or rock slides, unstable soils, seismic events, and soil contamination, and that the predicted effects from these hazards on the proposed Project be documented.

Good engineering design always involves consideration of these types of environmental effects and loadings or stresses on the project. The planning and engineering design for this Project are no exception. The methodologies used for mitigating potential effects of the environment on the Project are inherent in the planning, engineering design, construction, and planned operation of the Project.

5.12.1 Categories of Effects of the Environment on the Project

The types of effects caused by the environment on the Project would likely include the following:

- erosion;
- wind;
- floods;
- severe precipitation including snow drifting;
- land and rock slides and unstable soils
- seismic events;
- soil contamination;
- fog; and
- natural forest fires.

A discussion of each is provided below.

5.12.2 Effects Analysis

There is a number of planning, design and construction strategies intended at minimizing the potential effects of the environment on the Project so that the risk of serious damage to the Project or interruption of service can be reduced to acceptable levels. Mitigation measures include, but are not limited to, designing structures to relevant codes and scheduling of activities to accommodate weather interruptions. All of the construction activities will be taking place out-of-doors and thus weather has been and will be factored into the design, construction and operation of the Project.



A significant effect of the environment on the Project would be one that would result in a long term interruption in service or damage to infrastructure. There are alternative routes that would allow traffic to continue even if the proposed TCH was incapacitated, such as the existing TCH that will be maintained. At this time it is difficult to conceive of an event that would cause a significant disruption to the proposed TCH and yet not affect other transportation routes within the area. For the purposes of this assessment, a significant environmental effect would be one that results in repairs that could not be economically implemented.

5.12.2.1 Building and Design Codes

Specific codes and standards in the National Codes of Canada will address the specific issues related to environmental activities as described below. These codes and their titles are listed in Table 5.12.1.

5.12.2.2 Erosion and Unstable Soils

The potential effects of erosion on the Project may include, but are not limited to:

- erosion causing slope instability;
- sedimentation along drainage channels, resulting in improper function;
- erosion and washout around culverts; and
- degradation and break-up of pavement surface from ice and frost.

The geological setting of the Project area precludes the potential effects of natural erosion on the landscape (*i.e.*, flat rolling hills incised with abundant runoff channels, streams and rivers). Existing roads (*e.g.*, existing TCH) and developments within the Project area have not historically experienced landslides or slope failure.

Construction activities, as described in Section 3.0 of this report, include removal of the vegetative mat and exposure of soils. The rate of erosion of these disturbed/exposed surfaces can be thousands of times the rate from an undisturbed setting. The key to minimizing erosion is to minimize the exposure and extent of disturbance. Erosion potential will be identified during the detailed planning and design phase of the Project. Surveys and geotechnical investigations will be undertaken to identify areas of high erosion potential to ensure that the Project design incorporates appropriate erosion controls in these areas. Standard highway construction practices, techniques, and design strategies such as installation of erosion control structures, work progression, and appropriately sized armour stone for protection against erosion and scour ensure that the effects of erosion are minimized or prevented. A more detailed account of the proposed mitigation for reducing the magnitude and likelihood of erosion is presented in Section 5.3.5.2.1 (Surface Water VEC) and Section 5.4.5.2.1 (Fish and Fish Habitat VEC).



Table 5.12.1 Codes and Standards

CODE OR STANDARDS	TITLE
NBCC	The National Building Code of Canada
CAN/CSA-S6-00	Canadian Highway Bridge Design Code
NB DOT Standard Specifications	New Brunswick Department of Transportation, January 2003
Bridge Code	Ontario Highway Bridge Design Code, 3 rd edition
TAC	Geometric Design Guide for Canadian Roads, 1999
RTAC	Drainage Manual Vol. 1, 1982
A5-93	Portland Cement
CAN3-A23.1	Concrete materials and methods of concrete construction
CAN3-A23.2	Methods of test for concrete
CAN3-A23.3	Design of concrete structures for buildings
CAN3-A23.4-00	Precast Concrete – Materials and Construction
CAN3-A23.5-M86	Supplementary Cementing Materials
CAN3-S16.1	Limit states design of steel structures
CSA G30.3-M1983 (R1998)	Cold-Drawn Steel Wire for Concrete Reinforcement
CSA G30.5-M1983 (R1998)	Welded Steel Wire Fabric for Concrete Reinforcement
CSA G30.14-M1983 (R1991)	Deformed Steel Wire for Concrete Reinforcement
CSA G30.15-M1983 (R1998)	Welded Deformed Steel Wire for Concrete Reinforcement
CSA G30.18-M92	Billet-Steel Bars for Concrete Reinforcement
CSA G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel
CSA G164-M92	Hot Dip Galvanizing of Irregularly Shaped Articles
CSA-W186	Welding of reinforcing bars in reinforced concrete construction
CSA-C22.1	Canadian Electrical Code
S269.1-75	Falsework for Construction Purposes
S269.3-M1-92	Concrete Formwork
CSA W47.1-92	Certification of Companies for Fusion Welding of Steel Structures
CSA W48 Series	Electrodes
CSA W59-M1989	Welded Steel Construction (Metal-Arc Welding)
American Concrete Institute	
305R-99	Hot Weather Concreting
306R-88 (R1997)	Cold Weather Concreting
315-99	Details and Detailing of Concrete Reinforcement
347R-94	Guide to Formwork for concrete
American Society for Testing and Materials	
C 76-00	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C 260-00	Standard Specification for Air-Entraining Admixtures for Concrete
C 309-98A	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C 478-97	Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
C 494-99A	Standard Specification for Chemical Admixtures for Concrete
D 1751-99	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (No extruding and Resilient Bituminous Types)
Quality Assurance Code	
CAN/CSA – ISO 9001-00t	Quality management systems-requirements



Erosion of the pavement surface from freeze-thaw processes can result in cracks, potholes, and heaving. To the extent possible, pavement design codes incorporate regional extreme cold temperatures and freeze-thaw action to minimize these effects.

Regular inspections during construction and operation phases will be conducted to verify the effectiveness of the erosion control measures in place and to identify where additional measures or maintenance is required. It is not likely that erosion will have a significant effect on the Project.

5.12.2.3 Wind

Wind is not considered to be a significant factor in the construction of the ground-based portions of the Project. Wind will be a factor in the design of bridges and this is addressed in the building codes listed above. Wind will also be an issue for signage along the proposed TCH and is also addressed in the codes listed in Table 5.12.1.

Wind may be a safety issue during the operational phase of the Project on bridges/interchanges and in-filled valleys and rock cuts along the proposed TCH where there are areas of high exposure or wind tunneling effects. The maximum wind gusts recorded in the region (Fredericton to Saint-Léonard) range from 130 to 135 km/hour and occurred in the months of June and November respectively. The number of days per year when the wind exceeded 63 km/hour ranged from 0.26 in Fredericton to 0.38 in Saint-Léonard (Environment Canada 2002a). Therefore, while high wind events may occur on occasion, sustained high wind events are not frequent. Effects from extreme wind events during operation may be mitigated at the discretion of the NBDOT and RCMP officials with respect to the appropriateness of the temporary closure of these structures during periods of extremely high winds. It is not likely that winds will have a significant effect on the Project.

5.12.2.4 Floods

The Saint John River is currently dammed and/or redirected in several locations for the purposes of generating electrical power. Since the proposed TCH is not located immediately adjacent to the Saint John River, no portion of the proposed TCH is in any danger of flooding from the Saint John River.

The design standards for the larger watercourse crossing structures (*i.e.*, River de Chute, Big Presque Isle and Little Presque Isle Stream, Upper and Lower Guisguait Brook, Hunters Brook) will accommodate any reasonable anticipated increases in water levels in the respective watercourses they cross. Smaller watercourses crossed by the proposed TCH will be diverted through culverts of various designs (Section 2.2.3). All watercourse crossing structures (including culverts) will be designed to withstand the 1 in 100 year peak discharge event. It is not likely that floods will have a significant effect on the Project.



5.12.2.5 Extreme Precipitation

Precipitation can fall as rain, freezing rain or snow or as some combination of these depending on the time of year. The extreme daily rainfall recorded in the region ranged from 68.4 mm in Saint-Léonard (recorded in August, 1991) to 148.6 mm in Fredericton (recorded in August, 1989) (Environment Canada 2002a). The Fredericton Airport station has been reported data since 1951 while the Saint-Léonard station started reporting data in 1985. This may explain some of the disparity in these values. Extreme rain events during construction can create difficult and unsafe working conditions and may result in work stoppages. Rain is an expected work difficulty and the construction schedule considers delays due to potential rain events. In the event of extreme rain, compliance with Section 4.5 of the EPP and Section 4 of the EFG will ensure that erosion and sedimentation are addressed appropriately to minimize the potential environmental effects. If unusual wet periods or excessive rain events do occur, this can result in Project delays and an associated delay in completion and can result in additional capital cost.

Extreme snowfall can also affect winter construction or contribute to unusual flooding during snowmelt. The extreme daily snowfall recorded in the region ranged from 42.8 cm in Saint-Léonard (recorded in December, 1989) to 78.0 cm in Fredericton (recorded in December 1967) (Environment Canada 2002a). Exceptional early snowfall could delay construction and result in additional work for snow clearing and removal. This could increase construction costs. Early snow cover can minimize or prevent ground freezing and this may affect winter construction intended at improving work progress and accessibility.

Excess water is addressed by the proper sloping of the road surface to allow for run-off. Proper roadbed design prevents settlement and rutting which result in water pooling on the roadbed, potentially leading to hydroplaning. Water control off the road surface is mitigated through ditching along and between the lanes. These issues are addressed in the codes listed in Table 5.12.1.

Thunderstorms can produce extremes of rain and wind, however most of these storms are relatively short-lived. Over the period 1971-2000 there were on average 15 days per year with thunderstorms in the Fredericton area. These particular events were recorded during the months of May, June, July and August (Environment Canada 2002a). However, thunderstorms may occur outside of these months, and are possible during winter months in the Fredericton (and Project) area. Lightning activity in Fredericton has been reported by Environment Canada as 50 lightning flashes per year over an area of 100 km². In the same report, the detailed map indicates approximately 15-20 days per year with lightning for both cloud-to-ground and cloud-to-cloud lightning combined, averaged over 1998-2002 (Environment Canada 2003b).

During the operational phase of the proposed TCH, extreme rain may limit visibility. Ice and snow may interfere with the operation of vehicles on the highway. Ice and snow are controlled through



snowplowing, and sand and salting of the roadways. Snow and ice can result in visibility issues. Under extreme conditions operation of the proposed TCH can be temporarily suspended at the discretion of RCMP and NBDOT officials.

However, since the frequency of extreme events is low, this is highly unlikely for this portion of the proposed TCH.

5.12.2.6 Landslides

Landslides are mass movements of soil or rock downslope and are a major natural hazard in Canada. The hazard posed by landslides can be attributable to the impact of rapidly moving debris, the failure of ground directly beneath a structure, or due to secondary effects such as river damming or landslide generated waves. Natural Resources Canada maintains a database of major landslides (<http://atlas.gc.ca/site/english/maps/environment/naturalhazards/majorlandslides>). Historical reports indicate that landslides have resulted in many deaths in Canada and have caused billions of dollars of direct and indirect damage to Canada's economic infrastructure.

The majority of major landslides recorded in Canada have occurred in or west of Quebec. There are no reported occurrences of major landslides in the Project area. The geology and topography of the Project area (low, flat rolling hills along the river valley and older erosional sediments from weathering of the Appalachian Oregon and subsequent glaciation and resorting during the most recent geological time period) is not susceptible to landslides of this nature.

Rockfalls involve a smaller rock mass that breaks apart and falls, bounces, and rolls on steep slopes. They are a frequent problem along transportation routes and through rocky terrain and could interrupt service along a highway. As such, specific blasting techniques are employed during construction and safe set-backs from steep rocky slopes or cuts are maintained to minimize the potential effects of rockfalls on the Project.

Similarly, debris flows are smaller and less rapid forms of landslides. They occur when a saturated mass of surficial deposits moves down a steep stream channel. Debris flows are frequently triggered by heavy rains. Massive deposits of unstable soils susceptible to this form of landslide do not exist within the Project area. Geological investigations in support of the design of the proposed TCH will identify localized areas of soft soils.

Standard highway designs and construction specifications ensure that all cut and fill areas and ditches are prepared to a stable slope (typically 2:1) and are appropriately stabilized using hydroseed, mulch, erosion control blankets, and in some instances, rock armour to minimize or prevent debris flow. Areas



prone to high surface runoff are identified before and/or during construction and mitigative measures such as rock lined channels and diversion ditches are constructed.

It is not likely that landslides will have a significant effect on the Project.

5.12.2.7 Seismic Events (Earthquakes)

The Geological Survey of Canada maintains a National Earthquake Database (NEDB) containing information on Canadian earthquakes. Historical information, including location (*i.e.*, epicentres) and magnitude, for the North Appalachian Seismic Zone, within which the proposed Project is located, is available on-line at <http://www.seismo.nrcan.gc.ca>.

In New Brunswick, epicentres cluster in three regions, Passamaquoddy Bay region, Central Highlands (Miramichi) region, and Moncton region. Earthquakes have been more frequent in these regions and occasionally of a size to be potentially damaging (*i.e.*, larger than magnitude 5) such as the magnitude 5.7 earthquake in the Miramichi region in January 1982. Fortunately, because the immediate epicentral area was unpopulated, damage was very slight – a few hairline cracks but no structural damage in buildings up to 100 km away. The data indicates very few seismic events in the vicinity of the proposed Project area.

The proposed Project, and all related facilities, will be designed to the applicable standards for earthquakes in this area (Table 5.12.1). The intent of these design standards is to ensure the integrity of the facilities based on the level of risk for an earthquake in the area. Service could be interrupted due to earthquake damage in an extreme event. It is not likely that earthquakes will have a significant effect on the Project.

5.12.2.8 Soil Contamination

As previously discussed in Section 5.2.4.7, there are three abandoned dumpsites that are located within 500 m of the proposed RoW. Two of the sites are downgradient of the proposed RoW and the surface water and groundwater flow direction in the area of the third abandoned site would be expected to flow to the north, following topography towards the Lower Guisiguit Brook, approximately 140 m from the dump site. Additional mitigation measures during construction of the proposed TCH are not required.

Potentially contaminated sites, if encountered during Project construction, will be managed in accordance with the Guideline for Management of Contaminated Sites (NBDELG 2003c)). The site will be evaluated in a timely manner to determine whether there are off-site impacts or unacceptable on-site impacts and to minimize the effects on the Project construction schedule. Where environmental effects or risks are identified, NBDOT will:



- advise affected third parties, if appropriate;
- determine whether active remediation or ongoing site management is to be implemented; and
- submit a Record of Site Condition to NBDELG.

It is not likely that soil contamination will have a significant effect on the Project.

5.12.2.9 Fog

At times, portions of the Saint John River valley are prone to fog. The number of days with fog is reported as 41 per year, on average over the period 1971-2000. The highest number of events occurred in July, August, September and October (Environment Canada 2003). Most of the proposed Project alignment is at elevations above those typically affected by this phenomenon. Fog can, however, occur at any location along the proposed TCH under specific meteorological conditions. Under extreme conditions, operation of the proposed TCH may be suspended, but this is highly unlikely for this portion of the TCH. It is not likely that fog will have a significant effect on the Project.

5.12.2.10 Natural Forest Fires

There is potential for a natural forest fire to interrupt construction of the proposed Project. However, it is unlikely that fire could affect operation. New Brunswick has forest fire control programs in place to identify and control fires, minimizing the potential magnitude and extent of any forest fires and their environmental effects on the Project. Anthropogenic forest fires are considered accidents or unplanned events and are addressed elsewhere in relation to specific VECs. It is not likely that fire will have a significant effect on the Project.

5.12.3 Significance

Based on a consideration of the various mitigative strategies and designs applied, as described above, it is concluded that the effects of the environment on the Project are not significant.



5.13 Follow-up Program

5.13.1 Introduction

This section of the CSR outlines the need for and requirements of a Follow-up Program as outlined in the Guidelines (Appendix A) and CEAA (Section 16(2)(c)). "Follow-up Program" means a program for:

- verifying the accuracy of the environmental assessment of a project; and
- determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the Project.

To that end, NBDOT is fully committed to fund and conduct a focused Follow-up Program to meet one or both of these objectives, as applicable. Where it is applicable to do so, the program will establish baseline information that is necessary to support the Follow-up Program to meet these objectives. Such baseline data could form the basis for compensation where unanticipated environmental effects are identified through follow-up. Any additional baseline data (*e.g.*, groundwater TSS in wells near blasting zones) will be offered to Environment Canada.

In determining the recommendations for follow-up for each VEC in Sections 5.1 to 5.11, NBDOT has considered a number of factors:

- the level of confidence in environmental effects predictions;
- previous experience with planned activities and knowledge of the effectiveness of mitigation strategies; and
- the susceptibility of the VEC to potential environmental effects.

The Follow-up Program focuses on those potential environmental effects with the greatest risk of occurring or the uncertainty in their prediction.

Section 5.13.3 outlines the proposed elements of Follow-up Programs for each VEC. The elements of the program are described, and as applicable, the location, frequency and duration of the follow-up are described. Generally speaking the Follow-up Program will be implemented by NBDOT. NBDOT may delegate this responsibility to its developers or consultants, as applicable. Where developers have obligations in this regard, they will be contractually required to undertake the follow-up. Regardless, NBDOT is ultimately responsible and accountable for undertaking the program.



At this point in time, NBDOT is outlining its preliminary Follow-up Program. It is anticipated that the Follow-up Program will be designed in consultation with the Responsible Authorities and finalized and approved prior to implementation. Greater detail would be developed at that time.

Where non-compliance with the Follow-up Program is identified, NBDOT will take the following action. If developers are at fault, they will be obliged contractually to remedy or rectify the situation. Where NBDOT is directly responsible, the non-compliance will be rectified.

It is proposed that an annual Follow-up Program report be provided for as long as follow-up activities are required. All environmental-related monitoring results (e.g., pH of watercourses identified as potentially affected by sulfide bearing rock) will be provided to Environment Canada at quarterly intervals, or as it becomes available.

5.13.2 Mitigation Strategy

Section 3.0 of this CSR described the Project facilities and activities as designed and proposed. The proposed Project includes various design and environmental mitigation strategies that are intended to mitigate potential adverse environmental effects. The environmental effects analyses presented in Sections 5.1 through 5.11 present how these various mitigation measures and strategies will be implemented with respect to each potential environmental effect on each VEC. Section 5.12 describes how the effects of the environment on the Project will be mitigated.

Environmental protection measures have been developed by NBDOT as a result of legislative requirements and a desire to improve highway design and construction methods and procedures, and to minimize the interaction between the NBDOT activities and the environment. The EPP and EFG were developed in consultation with Environment Canada, DFO, Department of Fisheries and Aquaculture, NBDOE (now NBDELG) and NBDNRE (now NBDNR) to ensure that the mitigation contained therein are in compliance with regulatory requirements and that the potential environmental effects of NBDOT projects are managed and minimized so that significant environmental effects do not occur.

NBDOT will be responsible for managing the construction and operation of the proposed TCH and is committed to ensuring the Follow-up Program is developed and implemented through such means as construction contracts and appropriate training of NBDOT field staff. NBDOT is also responsible for preparation of environmental emergency response plans for the construction and operation phases of the Project. They are included in Section 8 of the EPP. NBDOT will ensure its developer(s) implement the mitigation measures and emergency procedures described in the EPP and EFG.



5.13.3 Proposed Follow-up Program

NBDOT will implement a Follow-up Program that combines the following elements:

- program objectives;
- establishment of baseline conditions;
- what, where, when, and how monitoring will take place;
- analysis and interpretation of results; and
- reporting.

The proposed preliminary Follow-up Program is described below for each VEC. This preliminary recommended Follow-up Program will be developed, finalized and approved in consultation with the Responsible Authorities, and other regulatory agencies as applicable. Protocols will be developed to assess the results of the Follow-up Programs. These results will be interpreted based on predictions contained within the CSR. If the follow-up program identifies unforeseen adverse environmental effects, then the existing mitigation measures will be adjusted or, if necessary, new mitigation or compensation measures will be developed.

5.13.3.1 Atmospheric Resources

Measurable environmental effects to air quality from dust and noise will likely be localized to the specific construction activities during construction and relatively localized during operation. In addition, there are currently several ambient monitors operated by NAPS / NBDELG in areas surrounding the proposed RoW. Provided the recommended mitigative actions are taken, additional monitoring of ambient air quality and noise is not warranted.

However, noise monitoring may be required to address any complaints from residents living near the highway. Where warranted, noise monitoring will be conducted at specific NSAs, in accordance with methodologies acceptable to NBDELG.

5.13.3.2 Groundwater

A groundwater Follow-up Program is recommended to establish baseline conditions prior to construction. Drilled wells within 500 m of blasting activity are included in this Follow-up Program. Monitoring will consist of an interview of the well owner, documentation of well construction specifics, collection of a water sample for chemical and bacteria analysis, and photographic documentation of the well location. Where several wells are present within the 500 m blast monitoring radius, selected representative proximity wells will be inspected, sampled, and closely monitored during the construction phase.



Also included in the groundwater Follow-up Program are dug wells located within 50 m of a major (> 5 m) overburden cut. These wells will be inspected (measuring depth, yield and water level in dug wells) by a licensed well inspector, and sampled for baseline water quality.

This Follow-up Program will be undertaken by the developer, on behalf of NBDOT. The developer will implement a contingency plan to provide temporary water during construction, and to repair or replace any wells found to be permanently damaged, in the event that wells are adversely affected by the Project. NBDOT will report the results of the Follow-up Program to NBDELG and Transport Canada.

Once the baseline is established, complaints or issues identified will be evaluated and compared to the baseline data.

5.13.3.3 Surface Water

The Project may result in residual environmental effects on surface water quality. In particular, total suspended solid (TSS) concentrations in watercourses may increase as a result of the mobilization of sediment from Project-related activities. An increase in TSS concentrations may elevate surface water temperature and increase the rate of sedimentation that may adversely alter fish habitat. In addition, the pH of surface water may be lowered (become more acidic) should water make contact with any sulfide bearing rock that may be exposed during Project-related activities.

The surface water monitoring program will consist of both compliance and effectiveness monitoring. During construction, compliance monitoring will ensure that all applicable environmental protection and permitting requirements for work within 30 m of a watercourse are followed, and that remedial action, if necessary, is successfully implemented. The surface water compliance monitoring will consist of the following core elements at all watercourses, as applicable:

- sampling of total suspended solids when precipitation events result in the visible overland flow of water;
- regular sampling of pH in watercourses where interaction with sulfide-bearing rock has been identified;
- inspection of all sediment and erosion control measures;
- inspection of hazardous materials storage areas (including possible sediment generating materials);
- inspection of watercourse crossing structures (including culverts) for verification of correct installation, and for subsequent signs of erosion or degradation (including beaver dams);
- development and maintenance of a log of erosion-prone areas;
- frequency of reporting to regulators; and
- exceedance thresholds and remedial actions.



The location and frequency of observations and the required sample size will be determined in consultation with NBDELG and DFO through their respective permitting and authorization processes.

Effectiveness monitoring for surface water is included in the description of effectiveness monitoring for Fish and Fish Habitat in Section 5.13.3.4.

5.13.3.4 Fish and Fish Habitat

The primary residual environmental effect of the Project on fish and fish habitat is the potential for the sedimentation of watercourses. The loss of fish habitat from installation of watercourse crossing structures will be mitigated by ensuring no net loss of fish habitat through habitat compensation. Watercourse crossing structures will be designed to allow for fish passage as required by DFO, where possible.

The fish and fish habitat monitoring will consist of both compliance and effectiveness monitoring. During construction, compliance monitoring will ensure that all applicable environmental protection and permitting requirements for work within 30 m of a watercourse are followed, and that remedial action, if necessary, is successfully implemented. Remedial action may involve fish rescue for de-watered sections of streams and/or near blasting areas. The fish and fish habitat compliance monitoring will be the same as that described in Section 5.13.3.3 for surface water monitoring.

Effectiveness monitoring for fish and fish habitat has the following four objectives:

- verify that mitigative strategies used during construction and operation have been effective;
- determine the total amount of HADD that occurred as a result of the Project;
- verify that habitat compensation, completed as part of the habitat bank, is operating effectively; and
- identify the need for, and carry-out, any additional habitat compensation.

The exact specifications of the fish and fish habitat and surface water monitoring program will be developed in consultation with DFO and NBDELG. The monitoring program will be subject to approval by DFO as part of the HADD authorization process and NBDELG as a part of the Watercourse and Wetland Alteration permitting process. This work will be undertaken in selected streams as determined through the authorization/permitting processes. The fish and fish habitat (and surface water) effectiveness monitoring will consist of the following core elements for comparison with pre-development baseline conditions:

- assessment of fish population and diversity (short term and long term);
- assessment of fish habitat;



- assessment of invertebrate population and diversity (short term); and
- a substrate and embeddedness study.

In addition, a fish passage study will also be conducted on a small number of watercourses to verify that design strategies for fish passage were effective.

The fish habitat assessment will use the NBDNR/DFO fish habitat assessment methodology (Hooper *et al.* 1995). The fish habitat assessment will also include measurements of pH and salinity in those watercourses identified, in consultation with DFO and NBDELG, as sensitive to these parameters.

5.13.3.5 Vegetation

NBDOT will undertake follow-up of rare plants that were observed within 50 m of the proposed RoW in the year following the completion of Construction and in the third year of operation. The follow-up will verify predictions made in the environmental assessment, and confirm the effectiveness of mitigation.

5.13.3.6 Wetlands

Additional monitoring is recommended beyond that which is stipulated in the EPP to ensure protection measures are used and are working. Wetlands within the Assessment Area will be monitored, within a short period after construction is completed, to visually assess wetland hydrology, introduction of invasive plant species, and used by recreational vehicles. The wetlands will be reassessed visually for the same parameters after a three-year period following completion of construction. NBDOT will negotiate a wetlands compensation plan that will be implemented as compensation for the project. Those negotiations will include the required follow-up that arises from that negotiation. Any follow-up identified in that process will become a part of the follow-up program as required under CEAA.

5.13.3.7 Wildlife

Monitoring of moose and deer in the vicinity of the proposed TCH is recommended in the short term to help fine tune the design of mitigation strategies (wildlife corridors and fencing). To aid in the design of wildlife corridors and fencing NBDNR and NBDOT will fly the alignment (Fall 2003) to understand the relationship between the topography and the proposed TCH to determine the need for structures and fencing. A follow-up aerial survey involving NBDNR personnel is recommended over the next winter to fine tune and confirm the high use areas that may warrant wildlife fencing, among other mitigation. NBDOT will continue to evaluate available technologies to keep moose off of highways and to provide information to motorists that will decrease the likelihood of collisions.



Other related follow-up is a recommendation for NBDOT to work with the CVFPMB to encourage the management of regenerating forest habitat near the Project footprint, so it is less attractive to moose and deer as browse. Existing management programs and money are already available to private woodlot owners, and managed by the CVFPMB. In addition, land that has already been cut, but will be within the RoW purchased by NBDOT should be managed using standard silvicultural techniques.

5.13.3.8 Land Use

No significant environmental effects were identified. However, monitoring may be required if potential environmental effects are identified (e.g., noise-related complaints). This would likely entail traffic counting and noise monitoring as discussed further in Section 5.1.6 (Atmospheric Environment VEC).

A further consideration for monitoring and follow-up would be to confirm that the established recreational trails maintain continuity across the RoW.

5.13.3.9 Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons

In order to keep the lines of communication open between NBDOT and the Maliseet First Nation communities it is recommended that, in consultation with the six Maliseet Chiefs, the Maliseet Nation Liaison Committee be established and that NBDOT create and fill the position of the Aboriginal Coordinator. This effort can only be accomplished if there is the desire and cooperation of the six Maliseet communities. While NBDOT will be the catalyst for this effort, the ability for it to function properly and provide meaningful information to the communities must come from within the communities and their Chiefs.

NBDOT is committed to ongoing monitoring and, where practical, mitigation of issues raised and potential adverse environmental effects as a result of the Project on the current use of land and resources for traditional purposes that are identified by the Aboriginal Community throughout the construction of the Project.

5.13.3.10 Archaeological and Heritage Resources

It is recommended that archaeological monitoring be conducted, by a qualified archaeologist, during initial ground breaking activities within 100 m of the watercourse banks on either side of the Lower Guisguet River and the Little Presque Isle River (Hartland Interchange connector road) crossings. Monitoring at these locations is recommended in consideration of potential First Nation's concerns. The objective of the proposed monitoring is to prevent the loss of any potential additional information regarding archaeological and heritage resources at these locations.



If a suspected archaeological / heritage resources is encountered during construction, it is recommended that the procedures described in the EPP be followed, including the cessation of construction activities in the area of the discovery and contacting the provincial regulating agency, ASU, for direction on appropriate action.

NBDOT is responsible for ensuring that the recommended monitoring is undertaken and that the results of such monitoring are reported to Archaeological Services Unit, NBDELG, and Transport Canada.

5.13.3.11 Labour and Economy

No monitoring or follow-up is recommended. Should Project-related issues be identified in the Labour and Economy sector, NBDOT should follow-up on an issue by issue basis, where appropriate.



6.0 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

6.1 Methodology

Section 16(1)(a) of *CEAA* requires that every comprehensive study of a project shall include a consideration of any cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out. The *Cumulative Effects Practitioners Guide* (Hegmann *et al.* 1999) offers guidance on how to meet this requirement. The following numbered list outlines the framework that was used for the assessment of Project-related cumulative environmental effects in consideration of the requirements of the Act, the guidance of the Agency, and the Guidelines.

1. Identify the issues through scoping and select VECs on which to focus the cumulative environmental effects assessment.
2. Identify those past, present and future projects and activities that will be carried out, that could result in cumulative environmental effects in combination with those of the Project.
3. Summarize the residual environmental effects of the Project.
4. Identify issues and select indicators to focus the cumulative environmental effects analysis for each VEC.
5. Establish temporal and spatial assessment boundaries for each indicator.
6. Identify the likely interactions (*i.e.*, overlapping effects) between the Project and other past, present and future projects and activities that will be carried out.
7. Evaluate and analyze the cumulative environmental effects on each indicator based on historical trends and the existing conditions.
8. Evaluate and analyze the cumulative environmental effects on each indicator of the residual environmental effects of the Project in combination with those of other future projects and activities that will be carried out.
9. Summarize the cumulative environmental effects of all past, present and future projects that will be carried out, for each indicator.
10. Determine the significance of the cumulative environmental effects on the VEC by applying the residual environmental effects rating criteria, as applicable.
11. Outline any follow-up that is recommended in respect of cumulative environmental effects, beyond that recommended in relation to the Project.

6.2 Selection of Valued Environmental Components

The Guidelines were developed in consultation with the federal and provincial regulators of the Technical Review Committee. The selection of cumulative environmental assessment VECs represents the concerns of those regulators and are reflective of the likelihood and magnitude of potential



environmental effects of the Project on the environment, as predicted at that time. The following list includes all VECs required by the Guidelines for the analysis of cumulative environmental effects:

- Moose and moose habitat;
- Species of special conservation concern (including migratory birds) and their habitat;
- Fish habitat and water quality;
- Agricultural land;
- Appalachian Hardwood Forest; and
- Wetlands.

For convenience of analysis, the suggested Species of Special Conservation Concern VEC is considered in three different VECs. Atlantic Salmon was selected as a VEC to address concerns regarding this species raised by DFO and during public consultation, and due to the likelihood that they may soon be under the protection of *SARA*. There are no other fish species of special conservation concern that have the potential to be affected by Project-related activities. Vascular plant species of special conservation concern (as designated by COSEWIC and ACCDC), are largely associated in the vicinity of the Project in the Appalachian Hardwood Forest. As a consequence, these vascular plant species are considered in this cumulative environmental effects assessment as a part of the Appalachian Hardwood Forest VEC. Migratory Birds of Special Conservation Concern was selected as a VEC to address concerns regarding these species as raised specifically by Environment Canada. There are no other wildlife species of Special Conservation Concern with Project-related residual environmental effects.

Table 6.2.1 provides the indicators that have been selected in consultation with the Technical Review Committee. The rationale for their selection is provided in each VEC section.

Table 6.2.1 VECs and Indicators for Cumulative Environmental Effects Assessment

Valued Environmental Component	Indicator(s)
Fish Habitat and Water Quality	Sedimentation
Atlantic Salmon	Upper Saint John River Atlantic Salmon Returns
Appalachian Hardwood Forest	Loss of AHF Habitat
Wetlands	Loss of Wetland Area
Moose and Moose Habitat	Moose Population
Migratory Birds of Special Conservation Concern	Mature Forest Migratory Bird Habitat Loss and Fragmentation
Agricultural Land	Agricultural Land Area



6.3 Identification of Past, Present and Future Projects and Activities

The selection of past projects and activities that may have had environmental effects that interact with those of the Project are selected separately for each VEC. The level of inclusion of these past projects in the cumulative environmental effects analysis is limited by the availability of data and information.

The selection of current and future projects was accomplished in consultation with NBDELG personnel (David Maguire and Bernie Doucet, pers. comm.). These other projects were selected based on their proximity to the Project, the possibility of interactions with the environmental effects of the Project, and the likelihood of the other project(s) being carried forward (*i.e.*, the project is registered with the Province under the *Environmental Impact Assessment Regulation*). In addition, the Technical Review Committee requested that all NBDOT Trans-Canada Highway projects between Saint-Léonard and Longs Creek (near Fredericton), also be included. These Projects are described although in several instances, Project-related environmental effects do not overlap with these other projects. As a consequence, other projects are considered within defined, VEC-specific environmental assessment boundaries, in a manner that affects both the availability of data regarding the environmental effects of past projects, and the degree to which Project environmental effects may overlap with those of other projects. The Moncton to Fredericton section of the TCH was determined to be unlikely to interact cumulatively with the residual environmental effects of the Project, and is therefore not included in the cumulative environmental effect assessment.

Current and future activities (*e.g.*, hunting and fishing) were selected based on public and regulatory consultation, and the professional observations and opinions of members of the field study teams.

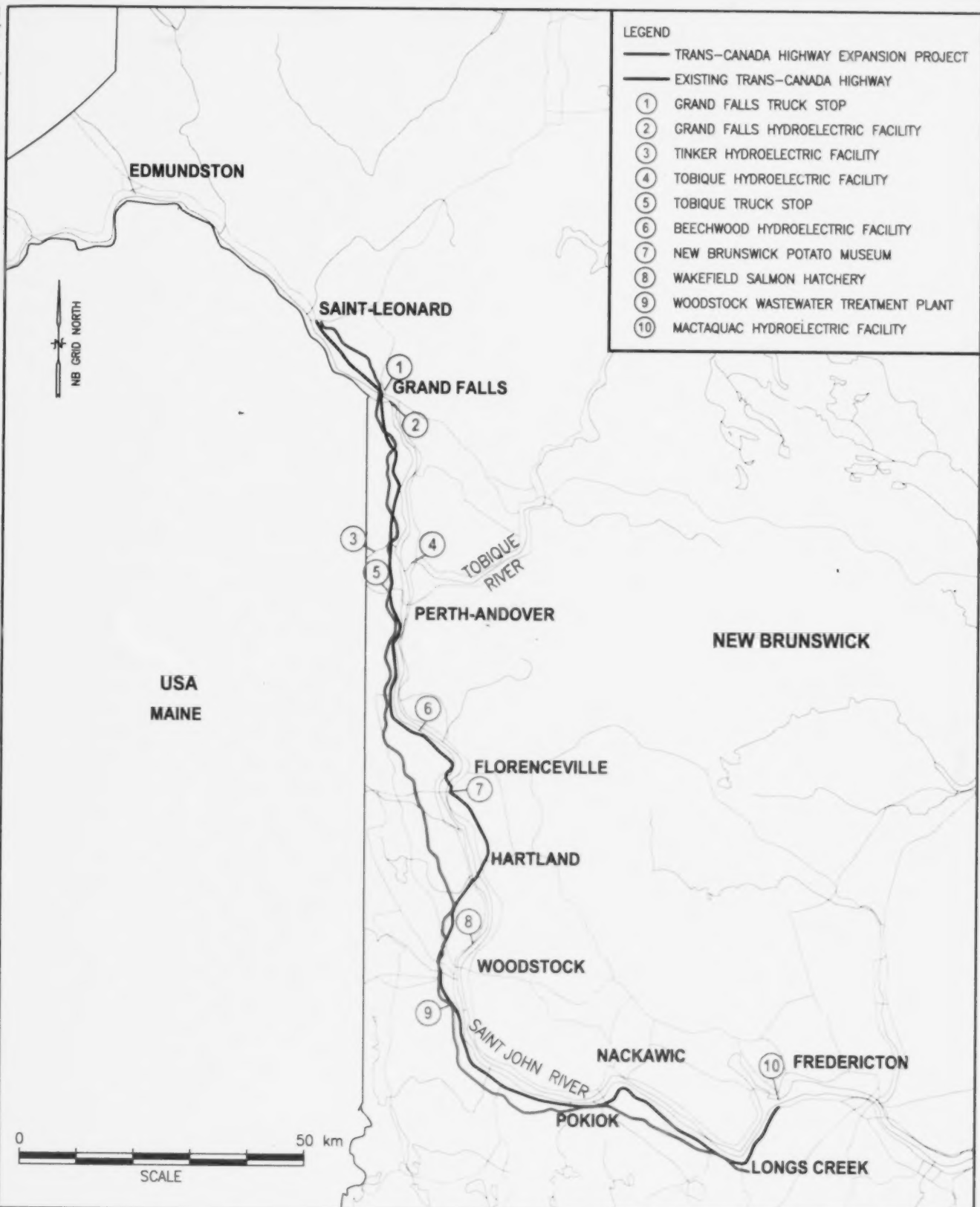
The other projects and activities that potentially act in combination with the environmental effects of the Project have been grouped into the following five categories:

- Existing Highways and Roads;
- Current and Future Highway Projects;
- Planned Development along Proposed TCH;
- Adjacent Land Uses; and
- Other Planned Development.

Figure 6.3.1 presents the location of each of the other current and future selected projects, and all sections of the Trans-Canada Highway (including the existing Trans-Canada Highway) between Saint-Léonard and Longs Creek. In addition, the locations of hydroelectric facilities are also presented. The location of activities is not presented in Figure 6.3.1 as they are dispersed or diffuse and not possible to effectively depict cartographically. Where possible within each VEC analysis, more specific location descriptions, or reference to other figures within this report, are provided.







LOCATIONS OF OTHER PROJECTS AND ACTIVITIES

Date:
2004 04 15

Scale:
AS SHOWN

Job No.:
14677

Fig. No.:
6.3.1



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Consulting Engineers
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6.3.1 Existing Highways and Roads

This category includes the existing TCH, as developed in the 1960's, other highway types (arterial, local and collector), secondary roads, and recently completed TCH projects.

The existing highways and roads carry traffic loads and therefore have associated noise, contaminant and greenhouse gas emissions, and the potential for wildlife encounters (e.g., vehicle-wildlife accidents). The construction of these roads resulted in the loss of forest and agricultural lands from service, the further division of the landscape, and the crossing of multiple watercourses. Some watercourse crossings may be acting as barriers or partial barriers to fish passage.

Activities that are ongoing or that are likely to occur on the existing highways and roads are primarily related to general maintenance. These include resurfacing, repainting of lines, maintenance of culverts and bridges, replacement of signage or guiderails, summer vegetation maintenance (e.g., mowing and tree cutting), and winter safety maintenance (e.g., sanding, salting and plowing).

6.3.1.1 Existing TCH

The existing TCH between Perth-Andover and Woodstock is approximately 76 km (between Route 190 and Route 550) in length, is a two-lane highway with occasional passing lanes (i.e., 3 lanes for short distances) and has an average purchased RoW width (including area of vegetation maintenance) of 80 m. It began its operational phase in the late 1960s. The total footprint is approximately 610 ha. The existing TCH crosses over to the east bank of the Saint John River between Florenceville and Hartland. It crosses a total of 43 watercourses (at district mapping 1:50,000 scale), not including the Saint John River, which it crosses in both Florenceville and Hartland. Fish passage has been impeded (e.g., from debris) at many of the smaller watercourses crossed by the existing TCH.

6.3.1.2 Local Highways and Roads

There are two arterial highways between Saint-Léonard and Longs Creek. These are Highway 95 (between Woodstock and Houlton, Maine), and Highway 3 (between Longs Creek and McAdam).

There are also some collector highways within this region. The collector highways that are within the region between Saint-Léonard and Longs Creek, in order of increasing distance from the Project, are Highway 190 (at Perth-Andover), Highway 107 (at Bristol), Highway 110 (at Florenceville), Highway 103 (between Florenceville and Bull's Creek near Woodstock), Highway 105 (along the east shore of the Saint John River between Grand Falls and Longs Creek), and Highway 122 (at Meductic).



There are six local highways that cross the Existing TCH or proposed TCH between Saint-Léonard and Longs Creek. The local highways that are within the region between Saint-Léonard and Longs Creek, in order of increasing distance from the Project, are Highway 560 (between River de Chute and Woodstock, Highway 555 and 550 (near Woodstock), Highway 375 (between Grand Falls and Aroostook), and Highway 635 (near Lower Prince William).

There are relatively few paved secondary roads in the vicinity of the Project. The majority of secondary roads are unimproved and were developed as access roads for agricultural or forestry use.

6.3.1.3 Saint-Léonard to Grand Falls TCH

The project includes highway upgrading activities between Saint-Léonard and Grand Falls to increase the capacity of the TCH and to improve the safety of the motoring public. The nearest location of this section of highway is approximately 35 km from the Project. This section of highway opened in December 2003. This project included the construction of a new section of four-lane divided paved highway, totaling approximately 17 km in length. The total footprint of the project is approximately 240 ha. The project crosses 13 watercourses. A twin structure crossing the Saint John River was required on the south side of the existing structure at Grand Falls. The project was subject to a screening level environmental assessment under *CEAA*, and was screened out under the New Brunswick environmental impact assessment process (NBDOT 2001, 1999a, b).

6.3.1.4 Perth-Andover By-Pass TCH

Recent activities included upgrading the existing by-pass over Route 190 to facilitate access for motorists departing Perth-Andover. The nearest location of this section of highway is immediately adjacent to the northern limits of the Project. This 7.3 km section of the proposed TCH is a component of NBDOT's four-lane initiative, and carries traffic on new eastbound lanes. However, the project included some twinning on portions of both the east and west-bound lanes. The total footprint of the project is approximately 50 ha. The project crosses 9 watercourses, the majority of which are unnamed tributaries of the Saint John River. The project was opened in November of 2003. The project was subject to a screening level environmental assessment under *CEAA*, and was registered under the New Brunswick environmental impact assessment process.

6.3.1.5 Woodstock to Pokiok TCH

This stretch of the TCH was opened in late 2003. The nearest location (Bull's Creek) is approximately 5 km south of the southern limits of the Project. This section was divided into 2 sections (Bull's Creek to Meductic, and Meductic to Pokiok) during the planning and environmental assessment phase. The project included the construction of a new section of four-lane divided paved highway, totaling 28.5 km



in length and the twinning of a 5.2 km section of the existing TCH. The total footprint of the project is approximately 425 ha. The project crosses 17 watercourses (9 watercourses for Bull's Creek to Meductic and 8 watercourses for Meductic to Pokiok). The projects were subject to screening level environmental assessments under CEAA, and under the New Brunswick environmental impact assessment process (NBDOT 1998a, b).

6.3.2 Current and Future Highway Projects

This category includes sections of the TCH that are currently under development, or that are scheduled for development within the next 5 years.

6.3.2.1 Grand Falls to Aroostook TCH

Plans are in place (pending regulatory approval) for the future construction of a 30 km long stretch of twinned, divided and paved highway located between Grand-Falls and Aroostook to increase the capacity of the TCH and to improve the safety of the motoring public. The nearest location (Aroostook) of this section of highway is 7.3 km north of the northern limit of the Project (Perth-Andover). The project will result in the permanent loss of 331 ha, of which approximately 250 ha are forested land and 35 ha are agricultural/grass land. The project crosses 15 watercourses, the largest being the Aroostook River. Clearing and grubbing may begin as early as the fall/winter of 2004. The project will be completed during 2007. The project is the subject to a screening level environmental assessment under CEAA, and was registered under the New Brunswick environmental impact assessment process (JWEL 2004).

6.3.2.2 Florenceville Bridge and Route 110 Interchange

The undertaking will consist of upgrading the interchange movements for the TCH and Route 110 in the Village of Florenceville. This project is located within the spatial limits of the Project. A short on ramp from the existing Route 110 to the TCH will be removed. It will be replaced with a realignment of Route 110 and Hume Road, as well include new on/off ramps to and from the eastbound lane of the TCH and a left-turning lane from the westbound lane. This project is scheduled for completion in 2005.

6.3.2.3 Lockhart Mill Interchange TCH

The Lockhart Mill Interchange project is proposed to improve conditions at that location in the immediate future, and provide for improved functionality when the Perth-Andover to Woodstock TCH project is completed. This project is located within the spatial limits of the Project. The proposed upgrade consists of a number of elements. These include the construction of 2 km of adjacent sections of the existing TCH and an interchange at the Lockhart Mill Road with on and off ramps, removal of the



existing TCH eastbound on ramp, upgrading of 230 m of the Sawyer Road, and construction of a watercourse crossing. The project crosses one unnamed watercourse. This project will be completed in 2004. The project was subject to a screening level environmental assessment under *CEAA*, and was registered under the New Brunswick environmental impact assessment process (ACER 2002).

6.3.2.4 Meduxnekeag River Bridge TCH

The existing 45 year-old Meduxnekeag River Bridge No 2. (east bridge structure) is showing indications of progressive deterioration. The roadway surface is narrow compared with today's standards and the lightweight metal guide rail system does not present the confinement to prevent errant vehicles from exiting the bridge deck, in the event of an accident.

The undertaking will consist of the complete replacement of the east bridge structure with a new modern bridge structure. The bridge is a major structural element of the Provincial Highway System carrying the westbound lanes of the TCH across the Meduxnekeag River Valley near the Town of Woodstock, New Brunswick. This will involve the removal of the existing 11 pier foundations and the installation of 5 new pier foundations. The total length of the proposed new bridge structure is approximately 353 m, which is slightly longer than the original structure, and will be designed to meet the current Canadian Highway Bridge Design Code. The new bridge structure will also be designed to be aesthetically similar to the existing Meduxnekeag River Bridge No. 1 (west bridge structure). In addition, the west bridge structure will undergo some refurbishment. This project was registered in January 2004, and will require federal funding and therefore will require an environmental assessment under *CEAA*.

6.3.2.5 Route 95 (Woodstock to Houlton)

Route 95 (Woodstock to Houlton) is an existing paved highway consisting primarily of two lanes. The nearest location (Woodstock) of this section of highway is immediately adjacent to the southern limit of the Project. The highway is approximately 12.2 km in length stretching from Woodstock, NB to Houlton, Maine. Potential future plans for this highway are to upgrade it to a four-lane highway to facilitate traffic flow between the Interstate 95 at Houlton and the TCH at Woodstock. The highway will be twinned by widening the RoW on the north side of the existing road. The total footprint of the project is approximately 200 ha. The project will cross 5 watercourses, and two additional watercourses are likely within 30 meters of the RoW. The project may also cross the edge of a wetland. This project was registered in January 2004, and will require federal funding and therefore will require an environmental assessment under *CEAA*.



6.3.2.6 Pokiok to Longs Creek TCH

Plans are in place for the future construction of a 33 km long stretch of four-lane, divided and paved highway, located between Pokiok and Longs Creek, New Brunswick, to increase the capacity of the TCH and to improve the safety of the motoring public. The nearest location (Pokiok) of this section of highway is 25 km east of the southern limit of the Project. Longs Creek is 58 km from Woodstock. The project will result in the permanent loss of approximately 450 ha of forested land and 4 ha of agricultural/grass land. The project crosses 16 watercourses, the closest to the Project being Allandale Stream. Clearing commenced in the winter of 2004. The project will be completed during 2006. The project was subject to a screening level environmental assessment under *CEAA*, and was registered under the New Brunswick environmental impact assessment process (JWEL 2003e).

6.3.3 Adjacent Land Uses

This category includes all adjacent land uses, that are not related to a specific project, that may have overlapping environmental effects with those of the Project.

6.3.3.1 Forest Resource Harvesting

Forest resource harvesting activities in the vicinity of the Project is extensive (Section 5.11.3.6) and consists of both the harvesting of wood for commercial profit (*e.g.*, woodlots) and for domestic (*e.g.*, personal) use.

6.3.3.2 Agriculture

Agricultural land use in the vicinity of the Project is extensive (Section 5.11.3.5) and consists of both high yield commercial farming activities for profit and of low yield domestic (for personal consumption only) activities. The majority of the agricultural land located in the vicinity of the Project is used for the cultivation of potatoes in rotation with barley and fallow crops. Other agricultural activities on the adjacent or nearby land include the cultivation of wheat, berries, and vegetables, as well as the rearing of livestock.

6.3.3.3 Hydroelectric Power Generation

A series of hydroelectric power developments were constructed by, or purchased by, the New Brunswick Electrical Power Commission (NBEP) along the Saint John River. Table 6.3.1 provides general operating information for each facility. The first of these was constructed in the early 1950's on the Tobique Maliseet Nation Reserve at the Tobique Narrows of the Tobique River. The next facility was constructed at Beechwood and has a head of 17 m and is located 130 km upriver of what is now the



Mactaquac generating station. The Beechwood generating station contains a fish collection gallery and a mechanical skip-hoist that lifts fish over the dam into the headpond. The NBEPC purchased the Grand Falls generating station from International Paper in the late 1950's. The Mactaquac generating station was built between 1967 and 1980 and is located approximately 20 km upriver of downtown Fredericton. It has a maximum head of 35 m. Fish passage occurs through a fish collection facility situated at the base of the dam, which is comprised of a collection gallery, holding pool, crowder and hopper.

In addition to these NBEPC/NB Power owned stations, there is a small generating station at Tinker, NB, on the Aroostook River. The American-owned, WPS Hydroelectric Power Dam at Tinker is operated as a "peaking" station, where water is discharged for power generation during periods of high demand, and has no fish passage facilities.

Table 6.3.1 Saint John River Hydroelectric Facilities

Location	Operation	Generating Capacity	Fish Passage
Tinker	1925 to present	34 MW	No
Grand Falls	1931 to present	63 MW	Not required
Tobique	1953 to present	20 MW	Pool and weir
Beechwood	1957 to present	113 MW	Fish lift
Mactaquac	1967 to present	672 MW	Fish lift

There was a substantial amount of riparian land and vegetation lost due to the installation of hydroelectric generating stations in the 1950s and 1960s in the Upper Saint John River Valley. The greatest extent of flooding occurred as a result of the Mactaquac generating station and resulting Mactaquac Headpond. The upriver extent of flooding from Mactaquac is located between Woodstock and Beechwood. Riparian land loss upriver of the Beechwood generating station extends to Perth-Andover. This flooding was not as extensive as the Mactaquac Headpond because of the more steeply sloped topography, less river discharge, and natural upstream barrier at Grand Falls.

6.3.3.4 Pits and Quarries

A number of gravel pits and a few quarries have been developed in the region over the years. These are usually small operations (typically less than 10 ha), and historically, have not likely been approved by NBDELG. The one identified quarry is located south of the Meduxnekeag River. It is approximately 27 ha in size and was partially constructed within an AHF site.

6.3.3.5 Residential

Residential land use in the vicinity of the Project consists primarily of single unit residential dwellings.



6.3.3.6 Commercial

Commercial land use in the vicinity of the Project consists of various retail, service and hospitality businesses, including truck services, gas bars, convenience stores, motels, and restaurants.

6.3.3.7 Industrial

Industrial land use in the vicinity of the Project is limited to the McCain Foods production plant and the Potato Technology Centre. The Potato Technology Centre is located on Route 110 in Florenceville while the McCain production facility, also located in Florenceville, is located on the opposite side of the Saint John River from the proposed Project.

6.3.3.8 Hunting

The Project is located within Wildlife Management Zone 10. Zone 10 runs from Grand Falls to Woodstock from the US border east to Plaster Rock and Juniper Station. Zone 10 is an active hunting area (NBDNR 2003b) for deer (566 registered deer kills out of a provincial total of 6,443), black bear (125 kills out of provincial total of 1,905) and moose (65 kills out of a provincial total of 2,020). This hunting takes place on the wooded lands, both private and Crown land. This includes the private woodlots located along the proposed TCH and adjacent lands.

Aboriginal hunting within the area of influence of the Project has been identified for moose, deer and partridge. Hunting occurs throughout this range, however, the area south of Big Presque Isle has been identified as a key location.

There is some trapping activity within the proposed RoW and surrounding area for a range of furbearer species, such as fox, marten, fisher, beaver and bobcat. This is for recreation, commercial and animal control purposes.

6.3.3.9 Fishing

Historically, the Saint John River provided an excellent fishery for Atlantic salmon. Recreational fishing was popular along the main river, and many tributaries including the Aroostook River, Tobique River, Meduxnekeag River, and Big Presque Isle River. There was also an Aboriginal fishery in the Tobique and Aroostook Rivers. However, due to a diminishing stock, all fishing for Atlantic salmon within the Saint John River system has been suspended pending in-season review, since 1996.



6.3.4 Planned Development Along the Proposed TCH

This category includes planned developments along those sections of the TCH that have been recently developed, or are scheduled for development within the next 5 years.

6.3.4.1 Tobique Truck Stop (Perth-Andover)

The construction of the Tobique Truck Stop is expected to be completed in the Spring of 2004. The Tobique Truck Stop will consist of a retail gas outlet; diesel card lock system, car wash, convenience store, family-style restaurant, and truckers' lounge. The truck stop development is located in Perth-Andover, west of the Route 190/TCH intersection, directly south of the junction of the TCH east-bound lane on/off ramp from Route 190. The site has an area of 3.6 ha and was formerly an agricultural (potato) field.

6.3.4.2 Grand Falls Big Stop

The construction of the Grand Falls Big Stop is expected to commence in the spring of 2004. The Grand Falls Big Stop will be a typical Irving Big Stop consisting of a retail gas outlet, a diesel card lock system, a convenience store, a family-style restaurant, and truckers' lounge. The Big Stop development will be located in Powers Creek just north of Grand Falls adjacent to the recently constructed interchange section of the TCH. The site has an area of 5.4 ha and is currently an active agricultural (potato) field.

6.3.5 Other Planned Development

This category includes all other planned development that is likely to occur within the spatial assessment boundaries of the cumulative environmental effects analysis.

6.3.5.1 New Brunswick Potato Museum and Learning Center on Route 110

Plans are in place for the construction of a Potato Museum adjacent to the existing Potato Technology Centre located on Route 110 in Florenceville. The facility will be constructed on a 0.8 ha previously cleared field. The potato museum and learning centre will endeavour to promote all aspects of the potato industry with programming aimed at tourists, students, and those within the agricultural community. The facility will feature potato-related exhibits, potato food products, and interactive displays and is expected to attract tourism and visitors to the area.



6.3.5.2 Wakefield Salmon Hatchery

There is a proposed plan to construct and operate an Atlantic salmon hatchery in Wakefield, N.B. Wakefield is on the western shore of the Saint John River between Woodstock and Hartland. The salmon smolts would be sold for restocking purposes. The total project footprint is 0.8 ha of agricultural field, and is located 190 meters from the existing TCH. The source of water is groundwater and the project will require a water supply assessment. The project would likely be constructed in the summer of 2004.

6.3.5.3 Woodstock Wastewater Treatment Plant

There is a proposed plan to construct and operate a wastewater treatment facility between Beardsley Road and the Saint John River, just south of the town of Woodstock, New Brunswick. The facility will provide secondary treatment using a 6 acre irrigated lagoon. The treated water will be discharged directly to the Saint John River. The total cleared area for the project is 8 hectares of previously cut, mixed forest. Facility construction will result in the direct removal of fish habitat on an unnamed tributary of the Saint John River. Construction is likely to begin in the spring of 2004, and finish by December 2004.

No other current or planned future projects are known in the area based on consultations with the Project Assessment Branch and the Rural Planning District Commission of NBDELG.

6.4 Cumulative Environmental Effects Analysis of Fish Habitat and Water Quality

6.4.1 Summary of Residual Environmental Effects of Project

The residual environmental effects of the Project on fish habitat and water quality are primarily related to sediment from construction activities entering watercourses. Extensive best practice mitigation for preventing sediment from entering watercourses will be used during all phases of construction near watercourses. However, extreme weather conditions such as intense rain events coupled with spring snow melt may reduce the effectiveness of sediment control techniques. Winter conditions, including sporadic thaw events, also present additional challenges for the prevention of sedimentation. Project-related sediment will also enter watercourses during the operational phase from sand used for winter safety and from combustion-generated particulate matter. Therefore, sediment entering watercourses was considered to be a potential residual environmental effect of the Project.

The Project will require the installation of watercourse crossing structures (including culverts) on 43 watercourses. There are no existing data available on fish movement in watercourses crossed by the



Project, or in watercourses crossed by adjacent projects. However, the design of watercourse crossing structures will provide for the passage of diadromous and resident fish. Therefore, the obstructed or diminished movement of fish was not considered a potential residual environmental effect of the Project.

The operation of the existing TCH, provincial and municipal roads, and future TCH has the potential to contribute to salinization of watercourses immediately adjacent and downstream of the roadways, as a result of salt application for winter safety.

The Project will result in the direct loss of fish habitat where the streambed is replaced by a culvert, or where the streambed is relocated. However, any identified HADD will be compensated for so that no net loss of fish habitat would occur. Therefore, fish habitat loss was not considered a residual environmental effect of the Project.

6.4.2 Identification of Issues and Selection of Indicators

Based on the potential residual environmental effects of the Project, sediment entering watercourses has been identified as an issue for the assessment of cumulative environmental effects.

Atlantic salmon, brook trout and other salmonids require clean gravel for the successful incubation of eggs. Sedimentation may fill in the pore space in gravel with sand and fines, and thereby reduce the ability of water to flow through gravel, a process that is thought to supply the egg with oxygen and regulate temperature. Also, the eggs may become covered with sediment during the incubation period, which may reduce the survival rates of the eggs. For the purposes of this assessment, sedimentation is defined as the deposition of sand and fine particulate matter ("fines") on the streambed. This measure indirectly considers the related water issue of suspended sediment in the water column.

Sedimentation has been selected as an indicator to focus the assessment of the potential cumulative environmental effects of the Project on Fish Habitat and Water Quality. Sedimentation addresses the primary issue of sediment entering watercourses for both water quality and fish habitat. Sediment substrate data are available for most watercourses between Grand Falls and Longs Creek. Non-salmonid species of fish that may be present are less susceptible than salmonids to sedimentation and therefore the analysis focuses on this important issue for salmonids.

NBDOT is committed to developing and implementing best salt management practices in a continued effort to reduce the cumulative environmental effects of road salt on the environment. Data on historical trends in the salinization of watercourses in the Assessment Area are not available. Since the improvement in the management of salt is expected to slow or perhaps reverse possible past operational effects of other roads, operational environmental effects of other projects and activities including salinization is not considered further in this cumulative environmental effects assessment.



Table 6.4.1 identifies the potential interactions between the indicators and the other projects and activities identified in Section 6.3.

Table 6.4.1 Cumulative Environmental Effects Potential Interactions Matrix for Fish and Fish Habitat VEC

Past, Present or Future Project or Activity	FISH AND FISH HABITAT VEC INDICATOR
	Sedimentation
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	✓
Saint-Léonard to Grand Falls TCH	✓
Perth-Andover By-Pass TCH	✓
Woodstock to Pokiok TCH	✓
Current and Future Highway Projects	
Grand Falls to Aroostook TCH	✓
Florenceville Bridge and Route 110 Interchange	✓
Lockhart Mill Interchange TCH	✓
Meduxnekeag River Bridge TCH	✓
Route 95 (Woodstock to Houlton)	✓
Pokiok to Longs Creek TCH	✓
Adjacent Land Uses	
Forest Resource Harvesting	✓
Agriculture	✓
Hydroelectric Power Generation	
Pits and Quarries	✓
Residential	
Commercial	
Industrial	
Hunting	
Fishing	
Planned Development Along Proposed TCH	
Tobique Truck Stop (Perth-Andover)	✓
Grand Falls Big Stop	
Other Planned Development	
New Brunswick Potato Museum/Learning Center on Route 110	
Wakefield Salmon Hatchery	
Woodstock Wastewater Treatment Plant	



6.4.3 Assessment Boundaries

Data regarding substrate type data were collected during baseline surveys for all sections of the expanded TCH, using the NBDNR and DFO stream survey and habitat assessment method (Hooper *et al.* 1995). No additional data of this type have been identified to be available for this region. Fish that reside in watercourses above Grand Falls do not interact with those below. Therefore, the Assessment Area for the assessment of the potential cumulative environmental effects assessment of sedimentation includes all watercourses, from their headwaters (or the Maine border if the watercourse extends into Maine) to the confluence with the Saint John River, between Grand Falls and Longs Creek that are (or will be) crossed by the expanded TCH (Figure 6.4.1).

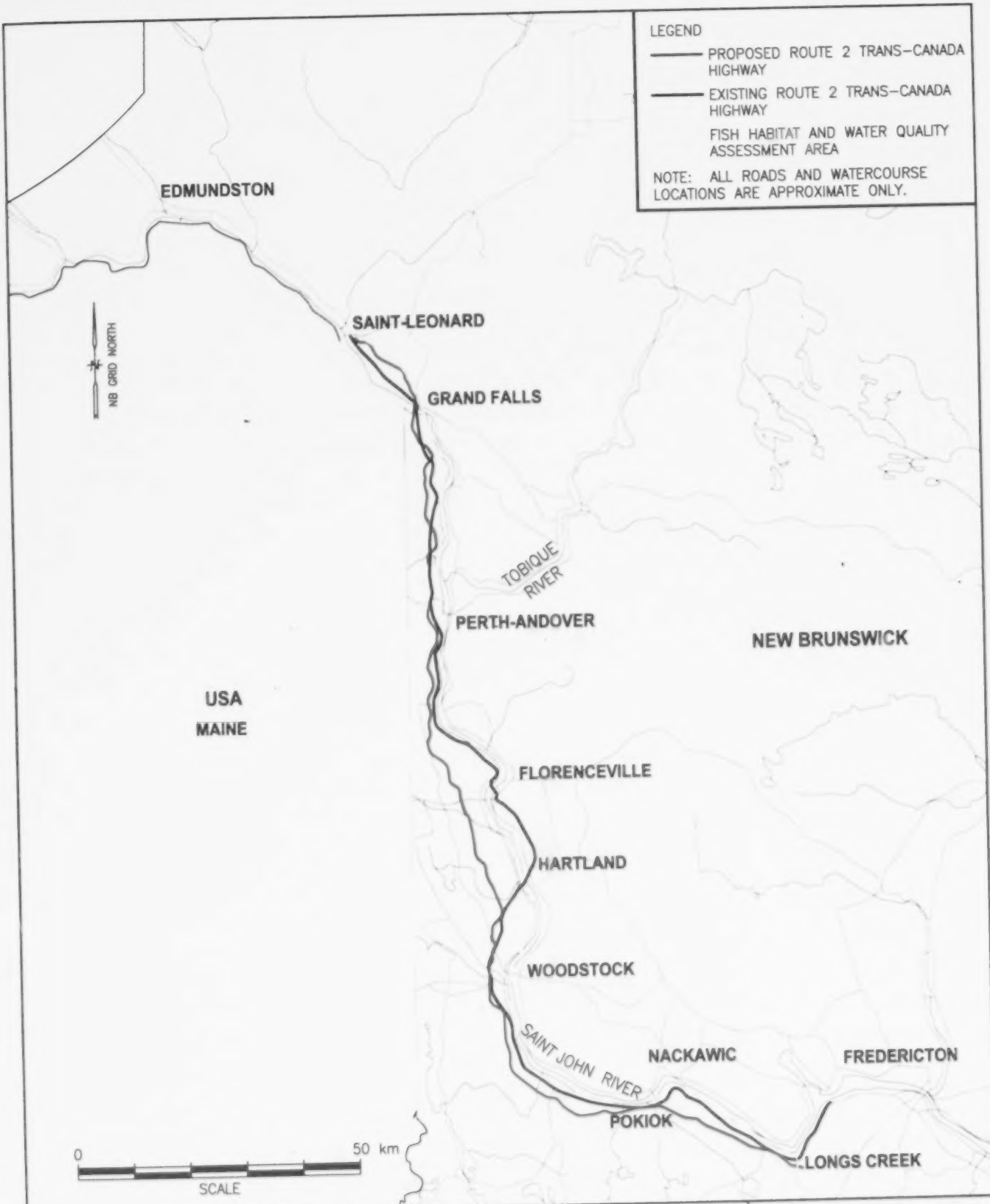
The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other past and present projects and activities is from the time of the baseline survey for watercourses crossed (or that will be crossed) by sections of the expanded TCH, to the present. Specifically, the temporal boundaries are:

- 2002 for the Project and the Grand Falls to Aroostook sections;
- 1998 for the Perth-Andover Bypass section;
- 1997 for the Woodstock to Pokiok section; and
- 2001 for the Pokiok to Longs Creek section.

No known data are available before that collected in baseline studies. However, it is argued that with respect to sedimentation, the conditions measured at the time of survey are to some considerable extent, representative of past and present projects and activities proximal to these streams, and reflect a temporal boundary that although indeterminate, may extend for many years prior to the year of the surveys, listed above. Therefore, the cumulative environmental effects assessment does relate these data to antecedent land use and projects.

The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other future projects and activities on sedimentation includes the next 5 years, beyond which forecasting of the likeliness of other projects to be carried out is not reliable.





SPATIAL BOUNDARIES FOR THE CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT OF FISH HABITAT AND WATER QUALITY

Date: 2004 04 15

Job No.: 14677

Scale: AS SHOWN

Fig. No.: 6.4.1



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6.4.4 Sedimentation

6.4.4.1 Historic Trends and Existing Conditions

Sediment grain size data for watercourses crossed by the proposed Project, the Grand Falls to Aroostook TCH, the Pokiok to Longs Creek TCH, and the Woodstock to Pokiok TCH, were obtained in pre-construction baseline surveys, using the NBDELG/DFO stream survey method (Hooper *et al.* 1995), that involves the estimation of grain size and percent total of the substrate through field observation. As such, there may be variation in recorded values due to biases of different field survey teams.

Hooper *et al.* (1995) suggest that road construction and forestry operations are primary causes of increased sediment in watercourses. Other anthropogenic activities cited as sediment sources in the CCME Guidelines for Total Particulate Matter (for the protection of aquatic life) include gravel pit operations, agriculture, dredging, industrial wastewater, and mining. Within the Assessment Area, the relevant dominant activities are forestry and agriculture. It should be noted that the expanded TCH crosses all watercourses upstream of the existing TCH. Therefore, it can be assumed that any degradation of fish habitat in the past from sedimentation, as observed during the stream surveys, has not been the result of the existing TCH. There are some secondary roads and other highways within the Assessment boundaries. For example, the Big Presque Isle Stream is crossed by Highway 560, improved secondary roads, and unimproved roads, upstream of the proposed TCH crossing. In such a case, the conditions measured at the time of the survey, reflect the total historical contribution of sediment from those roads (in combination with other adjacent land use) on the sedimentation within the watercourse.

In addition to anthropogenic causes, there are natural sources of sediment such as the natural erosion of bedrock and changes in flow patterns from vegetative obstructions (e.g., beaver ponds or digger log pools). The bedrock geology within the Assessment Area is primarily from one geological unit that is Upper Ordovician or Lower Silurian in age and is described as sedimentary rock deposited in a deep marine basin. This rock is well indurated (*i.e.*, hard and resistant to erosion) and is not likely to readily release substantial sediment into watercourses by way of natural erosion processes where bedrock is exposed. The overburden throughout the Assessment Area is a discontinuous veneer (*i.e.*, less than 0.5 m thick) of till that is comprised of silt, sand and gravel. In areas where the vegetative mat is removed, typically from agriculture or some forestry practices, this till is highly susceptible to erosion and may find its way to watercourses where it may settle to the substrate as sedimentation.

Table 6.4.2 provides the averaged degree of sedimentation (sand + fines) as a percentage of the total observable substrate in watercourses within sections of the proposed or completed TCH projects. Only those watercourses where data were recorded and where fish were observed were included in the analysis of percent sediment. The standard deviation was calculated to provide an indication of the variance of sedimentation across watercourses. Specific data for watercourses crossed by the Project are



in 5.4.3 (Fish and Fish Habitat VEC). Data for all watercourses in other sections are included in the environmental assessment reports specific to those projects (JWEL 2003a; JWEL 2004; NBDOT 1999a; NBDOT 1999b; NBDOT 1998a; NBDOT 1998b). These values are evidently reflective of the past and present input of sediment from adjacent land uses, including agriculture, forestry and other highways and roads. The percent sediment values suggest that sedimentation within watercourses crossed by the Project between Woodstock (Tributary to Meduxnekeag) and River de Chute (Tributary to Upper Guisiguit) are substantially higher than those in other sections. Appendix C (Figures 3.2A-D) depicts the land use surrounding each watercourse crossed by the Project. The maps clearly demonstrate that the density of agricultural land decreases from Woodstock to River de Chute. The area between River de Chute and Perth-Andover is predominantly covered by forest. This is due to the steep topography of that region. The most likely cause for the elevated percent sediment levels in watercourses between Woodstock and River de Chute appears to be the intensive agricultural land use within that area. An example is WC35 (Tributary to Little Presque Isle) that flows entirely through agricultural land. The substrate of WC35 is 100% fines. This pattern is observed in watercourses throughout this region.

The percent sediment values also suggest that watercourses between Woodstock and Grand Falls have experienced more sedimentation than those between Woodstock and Longs Creek, and the degree of sedimentation is most consistent between Pokiok and Longs Creek. The area between Woodstock and Longs Creek has very little agricultural land use. This would seem to support the hypothesis that agriculture is the largest contributor of sediment to watercourses in the Assessment Area.

Table 6.4.2 Average Percent Sediment in Watercourses Within the Assessment Area

TCH Section	Number of Fish Bearing Watercourses with Sediment Data	Average Observed Substrate Composition			
		% Sand	% Fines	% Sediment (sand+fines)	Standard Deviation of % Sediment (68%)
Grand Falls to Woodstock	13 / 15	18	17	35	17
Perth-Andover Bypass	5 / 9	23	17	40	8
Perth-Andover to Woodstock Wark Brook to River de Chute	14 / 18	15	13	28	15
Perth-Andover to Woodstock Tributary to Upper Guisiguit to Tributary to Meduxnekeag	21 / 24	22	36	58	40
Woodstock to Pokiok *	4 / 22	13	0	13	15
Pokiok to Longs Creek ** Allandale Brook to Obrien Brook	13 / 16	5	3	8	3

* Data not available for Woodstock to Meduxnekeag section
 ** Jewitts Creek has a high degree of sedimentation, however it is not included because it is not representative of other watercourses crossed in that section

The Project will contribute some sediment to watercourses that are crossed by the RoW. The contribution of sediment during construction will be prevented through use of sediment control measures as described in Section 5.4.5.2.1. The direct contribution of sediment to watercourses during operation of highways with similar traffic volumes (*i.e.*, 7,000 AADT) has been estimated as 186 kg/ha



of highway/year (Kobriger *et. al.* 1981). It should be noted that this value was determined at a time when vehicle exhaust contained more particulate matter than would be emitted by today's cleaner burning engines with advanced emission control devices. Also, not all sediment carried in highway runoff reaches watercourses. Much of the sediment will be trapped by vegetation and become part of the soil layer. The relative amount of contribution of the Project highway runoff to watercourses is discussed in Section 5.3.5.2 (Surface Water VEC). Increased mitigation will be in place in those watercourses where a potential sedimentation problem was identified.

6.4.4.2 Project Interactions with Other Future Projects and Activities

Existing Highways and Roads

There may be an overlapping contribution of sediment to the watercourse substrate, by the Project and the existing TCH, in areas downstream of the existing TCH. Any sediment, in addition to that already generated by the existing TCH, would be a result of winter sanding and not from combustion generated particulate matter as traffic volume is not anticipated to increase as a result of the Project.

Current and Future Highway Projects

Current and future highway projects that cross watercourses not crossed by the Project will contribute additional sediment to those watercourses. However, there will be no direct overlapping contribution of sediment from these other projects with those of the Project. The only exceptions would occur where the Project geographically overlaps, or abuts another project. This is the case at Perth-Andover (Wark Brook), at Florenceville (Saint John River), and near Woodstock (Meduxnekeag River). However, it should be noted that the division of these projects is for design and construction scheduling purposes only. The total environmental effect on specific watercourses (*e.g.*, Wark Brook) of developing these areas would not be greater than what is experienced at watercourses within the limits of the Project, because no additional development is occurring. The only difference would be in the timing of the occurrence, since these projects are being constructed at different times.

The only possible cumulative environmental effect of the Project acting in combination with other current and future TCH projects is the net loss of quality spawning or nursery habitat within the Assessment Area. However, there was no high quality spawning habitat located directly downstream (*e.g.*, within 200 m) of the Project RoW. In addition, the potential release of sediment from Project activities into watercourses will be mitigated as described in Section 5.4.5.2.1, and compliance and follow-up monitoring, where required, will ensure that mitigation is effective. Therefore, the Project is not anticipated to further degrade fish habitat within watercourses crossed by the Project.



Adjacent Land Uses

Agriculture is likely to remain the largest contributor of sediment to watercourses in the Assessment Area during the next 5 years, and may become more of a contributor if forest land continues to be replaced with agricultural.

If additional pits and quarries are developed, which is likely given the need for aggregate by the TCH projects, then additional sediment may enter watercourses in these areas. All pits and quarries developed for the purpose of providing material for the Project will be subject to the same sediment control techniques required for the Project.

6.4.4.3 Summary

Many of the watercourses within the Assessment Area have already experienced substantial amounts of sedimentation, particularly those watercourses between River de Chute and the Meduxnekeag River. Agriculture has likely been the largest contributor to sedimentation to watercourses within the Assessment Area in the past and present. Contributions of sediment from agriculture are likely to remain the same or increase during the next 5 years if current trends in agricultural land development continue. This may be offset by increasing application of Best Management Practices in agriculture (Land Use VEC; Section 5.8). The Project may contribute some additional sediment to the watercourses that it crosses. Sediment contributed from the Project to watercourses in those streams that have already experienced substantial input from agricultural practices will not likely further reduce the quality of fish habitat. There may be some reduction in the quality of fish habitat in those watercourses where sedimentation was not substantial (*i.e.*, less than 10 %) prior to potential sediment generating Project activities. Habitat compensation will be undertaken at a 3:1 ratio for all watercourse crossings where substantial instream work is required (*e.g.*, culvert installation and/or stream diversion). This compensation will ensure that a net gain of productive fish habitat is achieved. In addition, if substantial Project-related sediment accumulates downstream of Project activities, then additional habitat compensation may be required by DFO pursuant to Section 15(2) of the *Fisheries Act*. Therefore, any Project-induced sedimentation to watercourses will not result in a net loss of productive fish habitat.

Watercourses within the Assessment Area that are not crossed by the Project will not be directly affected by Project activities. The amount of sediment in watercourses between Woodstock and Pokiok should remain consistent into the near future, as there is not likely to be a substantial increase in agricultural land in that area. The amount of sediment in watercourses between Grand Falls and Aroostook is likely to increase as a result of increasing agricultural land use in that area.



6.4.5 Determination of Significance

The results of the stream substrate surveys suggest that there has already been significant cumulative environmental effects on fish habitat and water quality as evidenced by sedimentation in some watercourses between Grand Falls and Woodstock, including those crossed by the Project. However, no sensitive salmonid spawning habitat was identified within the RoW of the preferred Project alignment, or within 200 m downstream of the RoW. Sediment that results from Project-related activities will be controlled and monitored, where required, to ensure that further degradation of fish habitat within watercourses crossed by the Project does not occur. If Project-related destruction of fish habitat from sedimentation is identified, then DFO will require that habitat compensation be undertaken to ensure no net loss of fish habitat under Section 35(2) of the *Fisheries Act*. Therefore, the Project is not expected to have a net contribution to what are already significant cumulative environmental effects on fish habitat and water-quality within the Assessment Area.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.3 (Surface Water VEC) and Section 5.13.3.4 (Fish and Fish Habitat VEC), for the verification of the accuracy of the cumulative environmental effects analysis of fish habitat and water quality.

6.5 Cumulative Environmental Effects Analysis of Atlantic Salmon

6.5.1 Summary of Residual Environmental Effects of Project

The Project will involve the installation of watercourse crossing structures in 43 watercourses. Juvenile Atlantic salmon were identified in 3 of these watercourses, and may exist in others. The RoW alignment selection process, as detailed in Section 2.2, avoided sensitive Atlantic salmon habitat as identified in the baseline field survey. Furthermore, DFO (under Section 35(2) of the *Fisheries Act*) has required that habitat compensation must be completed to ensure that there is no net loss of fish habitat as a result of the Project where it is determined that the Project would result in a HADD. The Project is not anticipated to result in any likely residual environmental effects on Atlantic salmon populations or individuals. It is possible, but unlikely, that there could be mortality of juvenile Atlantic salmon, particularly during the construction phase of the Project, from accidents or unplanned events (e.g., chemical spills).

6.5.2 Identification of Issues and Selection of Indicators

Due to the extremely low numbers of Atlantic salmon in the Saint John River, concerns raised during public and regulatory consultation, and the likelihood that this stock will soon be under the Protection of *SARA*, the potential for the Project to contribute to cumulative environmental effects on the movement of Atlantic salmon has therefore been identified as an issue.



Atlantic salmon in the Saint John River is considered as the "Outer Bay of Fundy" stock by COSEWIC. The health of this stock is currently under investigation by COSEWIC, however it is not yet listed as a species of special conservation concern. Current threats identified by COSEWIC (2003) include:

- alteration of habitat by forestry and agriculture practices;
- damming of rivers and estuaries;
- by-catch in Shad and Herring fisheries;
- potential salmon farm threats such as disease or competition; and
- illegal fishing of wild salmon.

Marine survival in Canadian and international waters has also had a profound effect on Bay of Fundy salmon stocks in the past (DFO 2001). In the Bay of Fundy, commercial salmon fisheries have been suspended since 1990 in an attempt to conserve this diminishing stock. The Atlantic salmon commercial fishery along the eastern seaboard of the U.S. was closed in 1947. The last remaining large-scale fishery is off the coast of west Greenland. The Greenland fishery was closed in 2003, pending further review. There can be little doubt that all of these activities have had a cumulative environmental effect on the health of the Saint John River Atlantic salmon stock. However, specific data are lacking and there is little agreement amongst fishery biologists and other stakeholders as to the magnitude of these interactions. Therefore, this assessment will make no pretense at differentiating between the causality of declining stocks, and will instead focus on the overall health of the stock and the potential for the Project to affect the health of the stock. For this purpose, the Upper Saint John River Atlantic salmon returns has been selected as an indicator to focus the assessment of the potential cumulative environmental effects of the Project. This selection has been made because this is the stock within the watersheds crossed by the Project, and data (wild and hatchery salmon return numbers) are available.

Table 6.5.1 identifies the potential interactions between the indicator and the other projects and activities identified in Section 6.3.

Table 6.5.1 Cumulative Environmental Effects Potential Interactions Matrix

Past, Present or Future Project or Activity	ATLANTIC SALMON VEC INDICATOR
	Upper Saint John River Atlantic Salmon Returns
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	✓
Saint-Léonard to Grand Falls TCH	
Perth-Andover By-Pass TCH	✓
Woodstock to Pokiok TCH	✓



Table 6.5.1 Cumulative Environmental Effects Potential Interactions Matrix

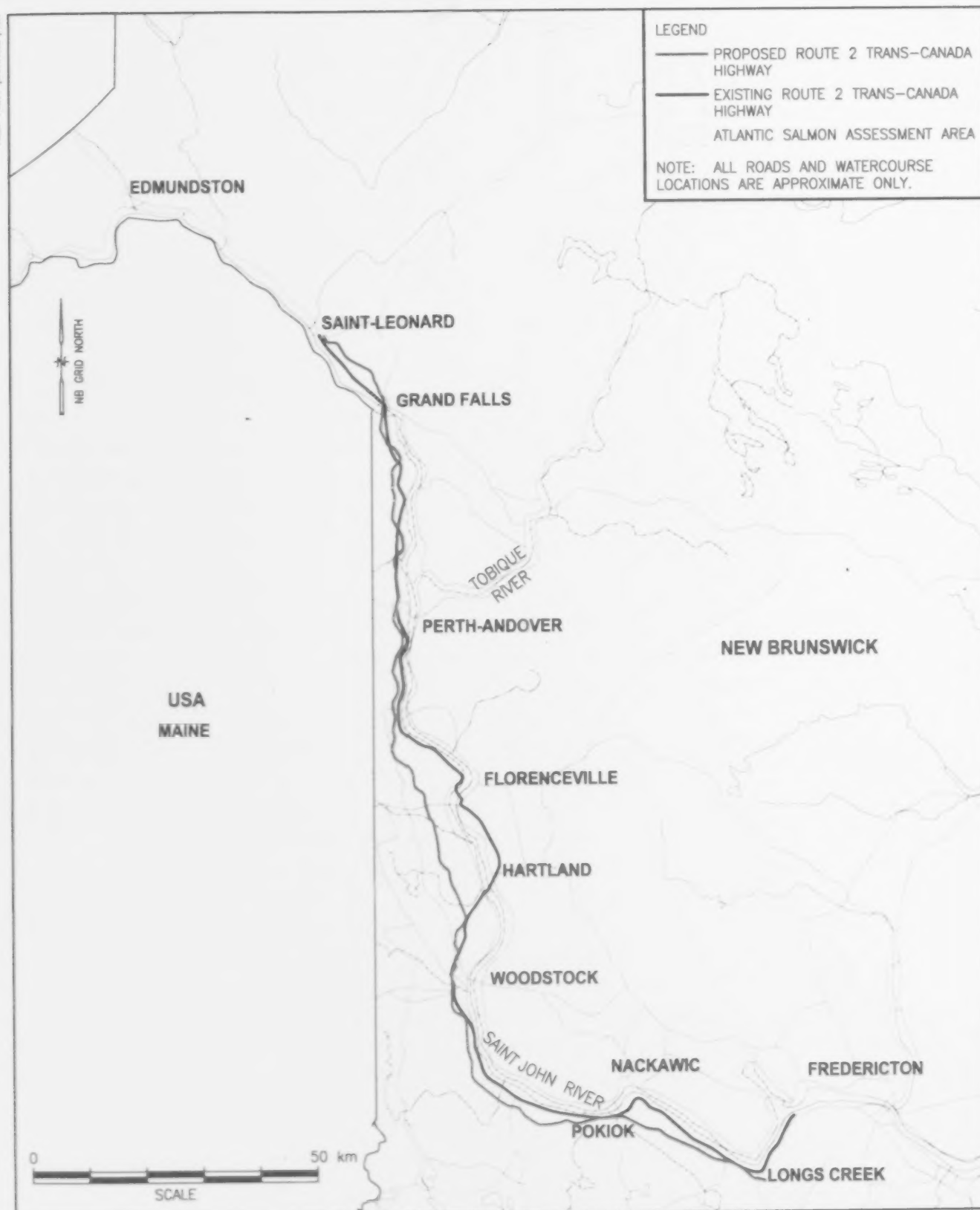
Past, Present of Future Project or Activity	ATLANTIC SALMON VEC INDICATOR	
	Upper Saint John River Atlantic Salmon Returns	
Current and Future Highway Projects		
Grand Falls to Aroostook TCH		✓
Florenceville Bridge and Route 110 Interchange		✓
Lockhart Mill Interchange TCH		
Meduxnekeag River Bridge TCH		✓
Route 95 (Woodstock to Houlton)		✓
Pokiok to Longs Creek TCH		✓
Adjacent Land Uses		
Forest Resource Harvesting		✓
Agriculture		✓
Hydroelectric Power Generation		✓
Pits and Quarries		
Residential		
Commercial		
Industrial		
Hunting		
Fishing		✓
Planned Development Along Proposed TCH		
Tobique Truck Stop (Perth-Andover)		
Grand Falls Big Stop		
Other Planned Development		
New Brunswick Potato Museum/Learning Center on Route 110		
Wakefield Salmon Hatchery		✓
Woodstock Wastewater Treatment Plant		

6.5.3 Assessment Boundaries

For the purpose of this assessment, it is reasonably assumed that all Atlantic salmon collected at the Mactaquac facility were migrating to destinations upstream of the facility. Adult salmon were historically known to spawn in the Meduxnekeag, Big Presque Isle, Aroostook and Tobique Rivers. Juvenile salmon likely used many of the smaller tributaries as rearing and nursery habitat. Atlantic salmon cannot traverse the waterfalls at Grand Falls. Therefore, the spatial boundaries for the assessment of the potential cumulative environmental effects of the Project on Atlantic salmon includes all watercourses, from their accessible headwaters (or the Maine or Quebec border) to the confluence with the Saint John River, between Grand Falls and Mactaquac (Figure 6.5.1).







SPATIAL BOUNDARIES FOR THE CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT OF ATLANTIC SALMON

Date:

2004 04 15

Scale:

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Environmental Scientists

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The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other past and present projects and activities on Atlantic salmon includes the time from the initial collection of salmon return data at the Mactaquac Hydroelectric Generating Station fish collection facility ("Mactaquac facility"), from 1970 to the present.

The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other future projects and activities on Atlantic salmon includes the next 5 years, beyond which forecasting of the likelihood of other projects or activities to be carried out is not reliable.

6.5.4 Upper Saint John River Atlantic Salmon Returns

6.5.4.1 Historic Trends and Existing Conditions

The size of the yearly Atlantic salmon returns in the Saint John River prior to settlement by people of European descent is not known. However, it is thought to have been as much as 1 million adult salmon. At least two centuries of intense harvesting occurred prior to the earliest reliable salmon return information in the Saint John River, which began with the construction and operation of the Mactaquac facility.

The Mactaquac facility is operated by the scientific and technical staff of the Diadromous Fish Division of DFO (Scotia-Fundy Region) who are responsible for research, assessment and free passage of the diadromous fish stocks, which include Atlantic salmon in the New Brunswick rivers flowing to the Bay of Fundy. The Mactaquac mitigation programs include live gene banking of New Brunswick's Inner Bay of Fundy Atlantic salmon (not Saint John River), the culture of salmon to replace the production lost to hydroelectric development on the Saint John River and trapping and trucking to transport upriver migrating fish whose passage is blocked by the Mactaquac dam. The hopper lifts upstream migrants into tank trucks for upriver distribution. All adult salmon captured in the migration channel at the Mactaquac Main Salmon Hatchery are sorted for broodstock and for transportation to a release site above the dam.

Recorded counts of adult Atlantic salmon stocks in the Saint John River were provided by DFO (Ross Jones, pers. comm.). The stock status was measured, from 1970 to 2002 (Figure 6.5.2), for both wild and hatchery adult salmon. In 1971, the return of wild salmon was 4,715 individuals while the return of hatchery salmon was 77 individuals. In 1980, both wild and hatchery returns were the highest on record, and had increased to 10,924 and 2,992 respectively. Since 1985, both wild and hatchery stocks have declined at an average rate approaching 50% per year. This trend continued into the 21st century with the most recent stock counts showing a return of 199 wild adult salmon and 177 hatchery adult salmon (DFO 2002).



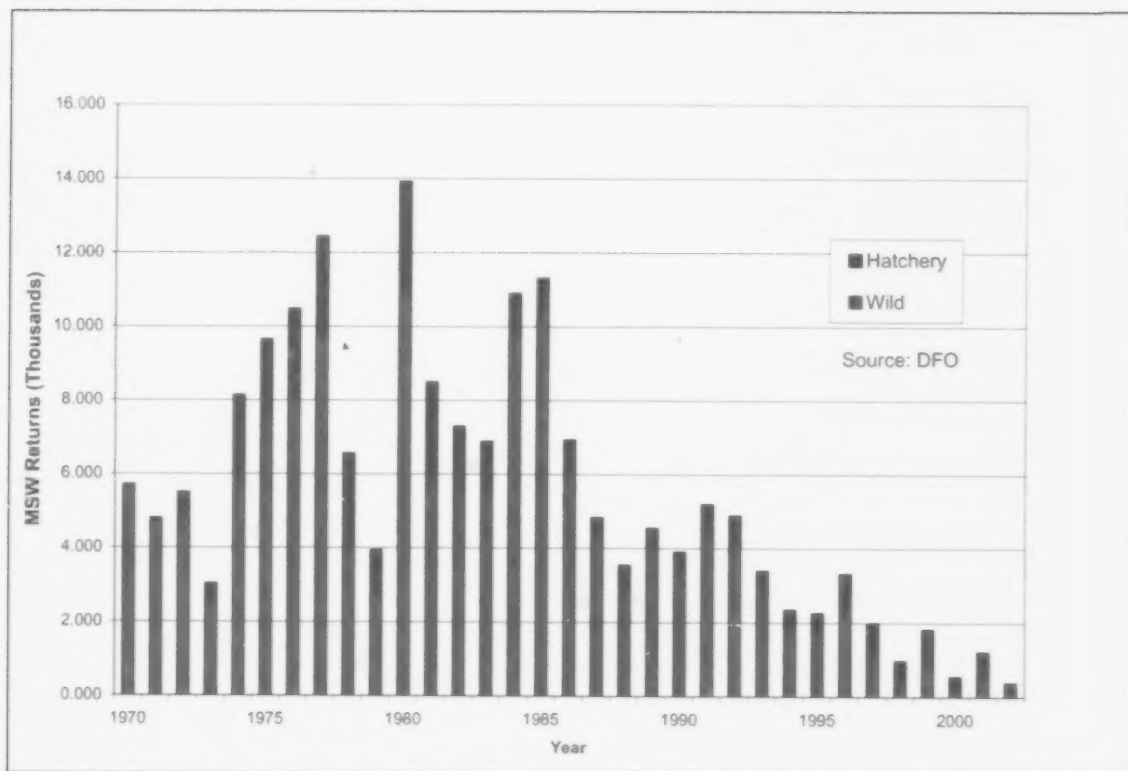


Figure 6.5.2 Atlantic Salmon Stock Returns (1970-2002): Saint John River at Mactaquac

6.5.4.2 Project Interactions with Other Future Projects and Activities

Existing Highways and Roads

The construction of the existing TCH and other highways (e.g., Highway 103) may have resulted in lost Atlantic salmon habitat and have, in some cases, created impediments to fish passage. The Big Presque Isle, Meduxnekeag, and Aroostook Rivers are all known to have been used for spawning and nursery habitat by Atlantic salmon. The installation of bridges in these watercourses may have removed some spawning habitat in the area of the bridge piers. However, the Project is not expected to result in the net loss of any spawning habitat, and therefore will not contribute cumulatively to the loss of spawning habitat in the Assessment Area.

There are more than 100 watercourses on the west bank of the Saint John River between Grand Falls and Mactaquac. Many of these provide nursery and rearing habitat for juvenile salmon before these fish begin their migration to the sea. Watercourse crossing structures, installed along the existing TCH, may obstruct migratory routes of Atlantic salmon in some watercourses. The watercourse crossing structures



of the Project will be designed to provide for passage of all fish, including Atlantic salmon, and will therefore not contribute cumulatively to the impediment of Atlantic salmon migration in the assessment area.

Atlantic salmon mortality could result from the unlikely event of a chemical spill along an existing highway or road, into a watercourse bearing Atlantic salmon. The Project is not anticipated to create additional traffic in the Assessment Area or increase the number of hazardous material transports. It is anticipated that the Project will result in a decreased accident rate. Therefore, the contribution of the Project to the cumulative environmental effect of spills in watercourses is considered neutral or slightly positive.

Current and Future Highway Projects

Current and future highway projects will be mitigated to allow for the successful migration of Atlantic salmon, and to ensure that there is no net loss of sensitive Atlantic salmon habitat. These projects may also help to reduce the likelihood of a hazardous material spill occurring during transport. Therefore, the Project is not anticipated to have overlapping adverse environmental effects on Atlantic salmon with those of the other highway projects.

Adjacent Land Use

The primary environmental effects from forest harvesting activities and agriculture activities on Upper Saint John River Atlantic salmon stocks are related to the loss or degradation of sensitive Atlantic salmon habitat (*i.e.*, for spawning or nursery). The RoW alignment selection process avoided any identified sensitive Atlantic salmon habitat. The Project will be mitigated such that there is no net loss, in area or function, of sensitive Atlantic salmon habitat by way of a compensation plan. Therefore, the Project is not anticipated to have any adverse residual environmental effects that overlap with those of forest resource harvesting and agriculture activities.

The primary environmental effects from hydroelectric generating stations on Atlantic salmon in the Saint John River are the obstruction to upstream and downstream migration, or mortality associated with downstream passage through turbines (Therrien and Bourgeois 2000). There is much disagreement amongst fisheries biologists and stakeholders regarding the environmental effects that the Saint John River hydroelectric generating stations have had on Atlantic salmon stocks. However, it has been determined that a series of small hydroelectric facilities within a single migratory route, can have a cumulative environmental effect on mortality rates (Therrien and Bourgeois 2000). This would be the case for any Atlantic salmon trying to reach a destination upstream of the Beechwood facility. A summary of the fish passage facilities at each of the major hydroelectric generating stations within the Assessment is provided in Table 6.3.1 (Section 6.3).



All watercourse crossing structures required for the Project will be designed so that fish passage is not impeded. As a result of mitigation, including seasonal scheduling of construction activities and the avoidance of Atlantic salmon habitat during the RoW alignment selection process, the Project is not anticipated to result in any Atlantic salmon fatalities. Therefore, the Project is not anticipated to have any environmental effects that overlap with those of hydroelectric facilities. It is possible, but unlikely, that there could be mortality of juvenile Atlantic salmon in particular during the construction phase from accidents or unplanned events. However, if this did occur, the event would be local and unlikely to affect more than a few individuals. Such an occurrence, albeit unlikely, would not be expected to exacerbate the current trends experienced by this stock.

Fishing for Atlantic salmon on the Saint John River has not been permitted since 1996, pending further review. Given the current status and trend of this stock, it would seem unlikely that fishing for Atlantic salmon in the Saint John River would be permitted within the next 5 years. Therefore, fishing is not likely to have any environmental effects that overlap with those of the Project on the Upper Saint John River Atlantic salmon stock.

Wakefield Salmon Hatchery

The Wakefield Salmon Hatchery will produce juveniles for restocking programs in the Saint John River. This may have a positive environmental effect on the number of hatchery salmon that return annually to the Mactaquac facility. The Project is not anticipated to have any adverse environmental effects that overlap with those of the proposed hatchery.

6.5.4.3 Summary

The current declining trend of the Upper Saint John River Atlantic salmon stock suggests that the stock may be near extirpation within the next 5 to 10 years. The contributions of the identified causes to this decline are not fully understood. The operation of a series of hydroelectric generating facilities will continue to impede the migration of Atlantic salmon within the Saint John River system. However, it should be noted that Atlantic salmon stocks in the lower Saint John River tributaries are declining at similar rates, and these fish are not affected by hydroelectric developments. Also, live gene banking capabilities at the Mactaquac facility may help prevent the extirpation of this stock if required.

There are no likely adverse residual environmental effects of the Project on any lifestage of the Atlantic salmon in the Upper Saint John River. There may be some localized mortality of juvenile Atlantic salmon associated with accidents or unplanned events during construction activities near watercourses, however this is considered unlikely due to mitigation such as seasonal scheduling of work near watercourses.



6.5.5 Determination of Significance

It is widely accepted that there have already been substantial cumulative environmental effects on Upper Saint John River Atlantic salmon stock from activities such as hydroelectric power generation and commercial fishing. However, there were no identified adverse residual environmental effects of the Project on this stock. Any environmental effects on this stock from Project-related accident or unplanned event are considered extremely unlikely. Furthermore, these environmental effects would be localized (within 1 watercourse) and short in duration (a few days). Therefore, the Project will not likely act cumulatively with any other projects or activities to exacerbate the current or predicted status of this stock (*i.e.*, contribute to or increase the current annual rate of decline of 50%). As such the Project is not expected to contribute to what are already significant cumulative environmental effects on the Upper Saint John River Atlantic salmon stock, and therefore all Atlantic salmon.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.4 (Fish and Fish Habitat VEC), for the verification of the accuracy of the cumulative environmental effects analysis Atlantic salmon.

6.6 Cumulative Environmental Effects Analysis of Appalachian Hardwood Forest

6.6.1 Summary of Residual Environmental Effects of Project

The residual environmental effects of the Project on Appalachian Hardwood Forest (AHF), following mitigation (including route selection and avoidance), are the loss of 6.8 ha of AHF in two moderate priority AHF sites. The mitigation proposed for the Project to protect rare vascular plant populations involves the purchase, for the purpose of conservation and protection, of 72.4 ha of currently unprotected private forest land considered to be very high priority and high priority AHF. These sites include rich assemblages of rare vascular plant species that would otherwise have no regulatory protection from future forest harvesting. These sites include (from north to south):

- the rich hardwood stand north of Demerchant Brook, containing a population of Canada violet;
- the rich hardwood stand north of Bryson Brook; and
- the stand containing bottle-brush grass, south of River de Chute and Route 560.

The first two sites are approximately 1 km apart, and therefore the land joining the sites is also being negotiated for purchase with the landowners, that will result in one large parcel totaling 48.8 ha. These sites contain a large number of rare species including Canada violet (S1/"May Be At Risk" species). The property purchased that encompasses the bottle-brush grass site south of River de Chute and Route 560, and west of the alignment totals 23.6 ha in area. This compensation ensures that there are no



unmitigated residual environmental effects on AHF and the associated rare vascular plant species. Most of the vascular plant species of concern recorded during field studies near the Project are species that characterize AHF, and that are in many cases persisting in the landscape despite the lack of a mature tolerant hardwood forest canopy.

6.6.2 Identification of Issues and Selection of Indicators

The key cumulative environmental effects issues regarding AHF are the direct loss of AHF from developments such as the Project and activities such as forestry and agriculture, as well as the associated loss of plant species of special conservation concern. Work commissioned by the Nature Trust of New Brunswick (NTNB) (MacDougall, 1997; MacDougall and Loo 1998; Betts 1999) provides good information on the history of AHF in the region and the ongoing threats to this habitat. The indicator chosen to address cumulative environmental effects on AHF and associated vascular plants of special conservation concern is the loss of AHF habitat (and by association its associated vascular plants of special conservation concern).

Table 6.6.1 indicates the projects and activities that may act cumulatively with the Project on AHF habitat as indicated by the loss of AHF habitat.

Table 6.6.1 Cumulative Environmental Effects Potential Interactions Matrix for AHF

Past, Present or Future Project or Activity	AHF VEC INDICATOR
	Loss of AHF Habitat
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	
Saint-Léonard to Grand Falls TCH	
Perth-Andover By-Pass TCH	
Woodstock to Pokiok TCH	
Current and Future Highway Projects	
Grand Falls to Aroostook TCH	✓
Florenceville Bridge and Route 110 Interchange	
Lockhart Mill Interchange TCH	
Meduxnekeag River Bridge TCH	
Route 95 (Woodstock to Houlton)	✓
Pokiok/Nackawic to Longs Creek TCH	
Adjacent Land Uses	
Forest Resource Harvesting	✓
Agriculture	✓
Hydroelectric Power Generation	
Residential	✓



Table 6.6.1 Cumulative Environmental Effects Potential Interactions Matrix for AHF

Past, Present or Future Project or Activity	AHF VEC INDICATOR
	Loss of AHF Habitat
Commercial	
Industrial	
Recreational (Including hunting/fishing)	
Planned Development Along Proposed TCH	
Tobique Truck Stop (Perth-Andover)	
Grand Falls Big Stop	
Other Planned Development	
New Brunswick Potato Museum/Learning Center on Route 110	
Wakefield Salmon Hatchery	
Woodstock Wastewater Treatment Plant	

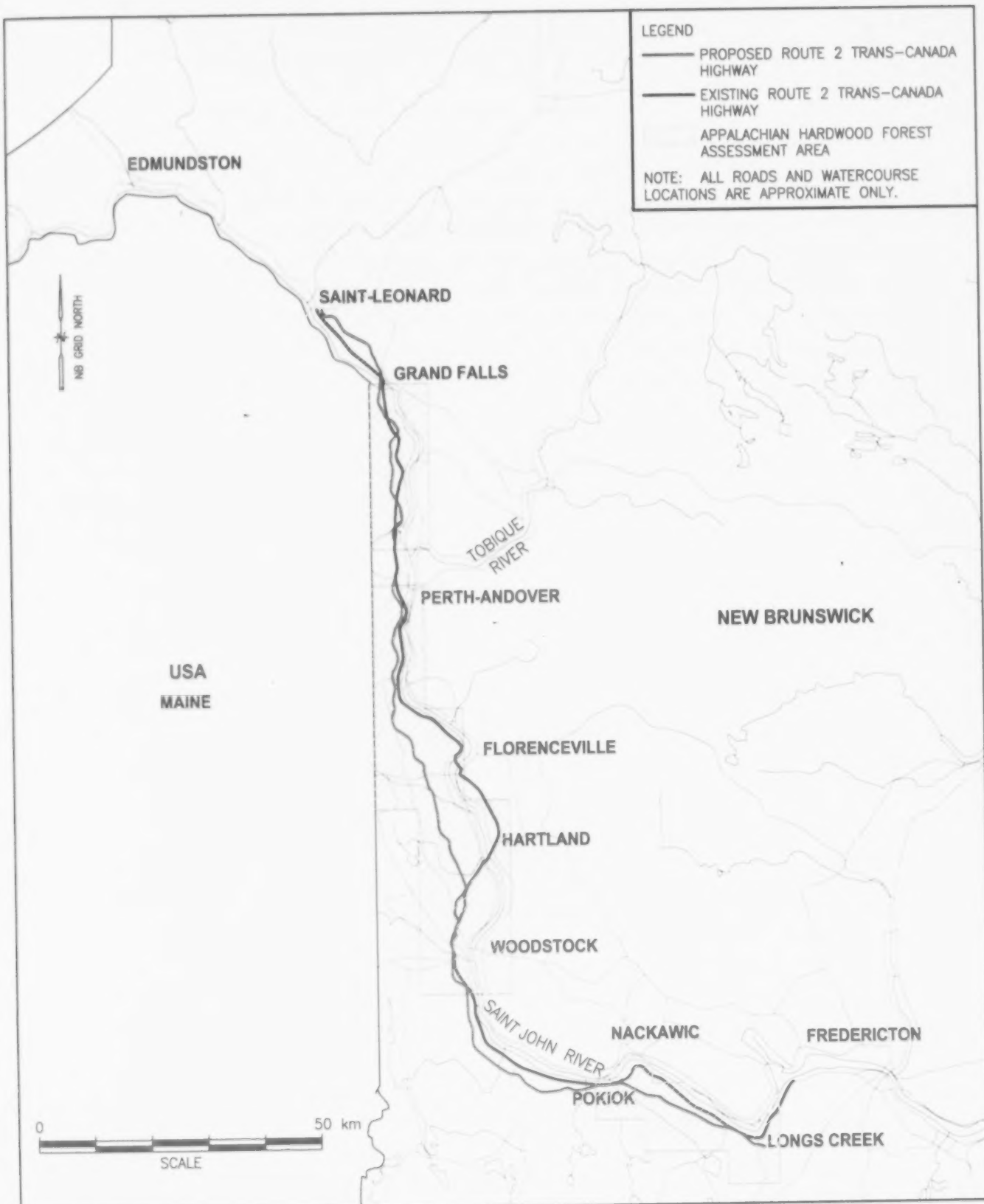
6.6.3 Assessment Boundaries

The spatial boundaries for the assessment of cumulative environmental effects assessment on AHF is the combined Assessment Areas used for the Perth-Andover to Woodstock and Grand Falls to Aroostook TCH project environmental assessments, the area within which detailed data have been analyzed for AHF. This Assessment Area was selected because of the data analysis conducted within those areas as they quantify AHF area losses due to past, present and future projects that overlap with the Project. Data for the larger area of AHF in the central Saint John River Valley are presented for historical trends and context (Figure 6.6.1).

Temporal boundaries for the cumulative environmental effects assessment of AHF include the period from the early 1980's to the present. This is based on available information on known stands of AHF within that time frame. Forest inventory mapping used for the Appalachian Hardwood Forest Conservation Stewardship Project (MacDougall 1997) was based on 1980's photography. The more recent Forest Inventory Database based on 1996 (north of River de Chute) and 2000 (south of River de Chute) aerial photography is used to describe changes in AHF habitat from land use activities to that point from the early 1980's. Temporal boundaries for the cumulative environmental effects assessment of future projects and activities that will be carried out include the next 5 years, beyond which forecasting is not reliable.







**SPATIAL BOUNDARIES FOR THE CUMULATIVE
ENVIRONMENTAL EFFECTS ASSESSMENT OF
APPALACHIAN HARDWOOD FOREST**

Date:

2004 04 15

Scale:

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Job No.:

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Fig. No.:

6.6.1



Jacques Whitford

Consulting Engineers
Environmental Scientists

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6.6.4 AHF Area

6.6.4.1 Historic Trends and Existing Conditions

Based on topography and soil type, MacDougall (1997) concluded that AHF historically occupied at least 200,000 ha in western New Brunswick. Much of this land was cleared in the 19th century and early 20th century for settlement, agriculture and forestry. In the 1930's and 1940's, much of these cleared lands were allowed to reforest. Based on the 1997 field surveys of the AHF Conservation Stewardship Project (MacDougall 1997), only 1,174 ha (0.8%) of land classified as suitable for AHF in the central St. John River Valley (147,338 ha) supported mature AHF stands (Betts 1999). Of the suitable land available, 55% has been cleared permanently for agriculture, settlement or roads (MacDougall and Loo 1998). MacDougall and Loo (1998) suggest that the AHF that remained after the period of intense clearing in the 19th century has remained stable for most of the 20th century. However, between 1981 and 1997, 44 of the 114 potential mature AHF sites identified from the 1980's forest inventory data had been partially or completely clearcut, and only seven sites showed no evidence of past cutting (MacDougall 1997).

Sixty-five known AHF sites were remaining in 1997. The mature hardwoods that make up the AHF stands are commercially valuable trees and there is pressure on landowners to clearcut (Peabody 1998). There are no regulatory restrictions on the harvesting of AHF on private land. NTNB has encouraged landowners to protect these remaining AHF sites by such measures as entering into stewardship agreements, but this has resulted in no substantive private conservation measures (J. Simpson, pers. comm.). The AHF sites are highly fragmented within the area studied. Betts (1999) calculated a mean nearest neighbour (the average distance that separates patches of the same type) of 1.28 km, demonstrating that the sites are widely spaced and isolated. Distance between patches is important because of the limited dispersal distances for many AHF plant species, depending on the dispersal method. A patch size distribution of the remaining AHF shows that 48% of the patches are under 10 ha, and 86% are under 40 ha (Figure 6.6.2). The smaller the patches the less forest interior is present, which is often required by most AHF species (Haase 1965 in Betts 1999).



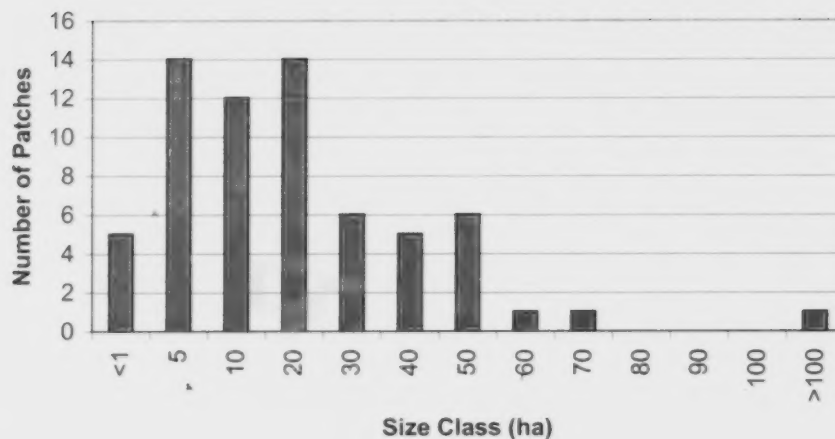


Figure 6.6.2 Distribution of known AHF patches from 1980's Forest Inventory Data and based on 1997 field visits, but not taking into account partially cut or clearcut portions of the sites, from Betts (1999).

AHF (as benchmarked by the 1980's forest inventory) was laid over the recent 1996/2000 forest inventory database. The analysis covers the Assessment Area. A total of 627.7 ha or 53.4% of the AHF is within the Assessment Area. This analysis shows that in this 15-20 year period, 67.8 ha of mature forest was lost from AHF sites due to forest harvesting. With other losses, the total AHF loss is 86.9 ha. This total loss includes 2.5 ha from agricultural land, 5.4 ha from other occupied land such as residential (mostly in a few AHF sites already in close proximity to roads and other residential development), 10.9 ha from a quarry site at the edge of the Meduxnekeag River AHF site, and 0.3 ha from a TCH twinning project.

The two AHF sites (AHF#30a and #28) that would be affected by the Project have been reduced in size since their delineation in 1997 from a total of 47.5 ha to 28.5 ha (a loss of 19 ha). The small AHF #30a comprised two small patches (3.8 and 5.2 ha) separated by a transmission line RoW and surrounded on three sides by agricultural land. These patches are currently 1.3 and 2.7 ha (respectively) due to forest cutting before 2000. AHF #28 at Big Presque Isle Stream also comprises two fragments (15.1 and 23.4 ha, historically) separated by a transmission line RoW. The smaller patch has been bisected by a large clearcut prior to 2000, and reduced to approximately 8.3 ha. The larger patch has been subjected to selective cutting over the recent past, resulting in a 16.2 ha stand as delineated in 2000; the landowner has more recently conducted selective cutting in this stand. Thus, as noted earlier, the total loss from the 1980's to 2000 for these two AHF sites is 19 ha, all attributable to clearcutting or partial clearcutting.

Currently, there are no Provincial regulations that manage or limit the extent of the conversion from forest to agriculture. Between 1991 and 2001 there was a 15% increase in potato production in the

region as noted in the Land Use VEC (Section 5.8) resulting in part from the conversion of forestland to agriculture. This trend is likely to continue into the near future as forestland is cleared to provide for the more profitable business of growing crops (particularly potatoes) on agricultural land. However, as noted above, only 2.5 ha of AHF has been converted to agricultural land in the Assessment Area between the 1980's and 1996/2000.

The existing TCH and most other local highways and roads were built prior to the temporal boundaries of the assessment. However, the twinning of the TCH just south of the Meduxnekeag River in 1996 resulted in the loss of approximately 0.3 ha of the Meduxnekeag River-Woodstock AHF site, due to the widening of the RoW. Although the recently completed Woodstock to Pokiok, Perth-Andover Bypass, and Saint-Léonard to Grand Falls TCH projects are near or within the historical distribution of AHF, there are no known AHF sites that were affected by the projects.

In summary, Betts (1999), based on the work by the Appalachian Hardwood Forest Conservation Stewardship Project (MacDougall 1997; MacDougall and Loo 1998), identified 65 AHF sites totaling 1,174 ha within his study area. Using the most recent available forest inventory data (based on 1996 aerial photography north of River de Chute and 2000 aerial photography south of River de Chute), there has been an estimated 86.9 ha reduction in AHF area in the Assessment Area since the early 1980's. Of the 627.7 ha of AHF within the Assessment Area, 67.8 ha has been lost from forest harvesting, 2.5 ha from agricultural land, 5.4 ha from other occupied land such as residential, 10.9 ha from a single quarry, and 0.3 ha due to the widening of the existing TCH. The 67.8 ha lost from forest harvesting includes the 19.0 ha of the two AHF sites affected by the Project, lost before 2000.

6.6.4.2 Project Interactions with Other Future Projects and Activities

As noted in Section 6.6.4.1, two AHF sites located within the Assessment Area proximal to the Project, were reduced by 19 ha before 2000. The small AHF #30a is made of two small patches (3.8 and 5.2 ha) separated by a transmission line RoW, and currently 1.3 and 2.7 ha (respectively) due to forest cutting. This site would be further reduced by the Project to approximately 1.1 and 1.5 ha, respectively. This is a net loss of 1.4 ha, attributable to the Project. AHF #28 at Big Presque Isle Stream is currently made of 2 fragments (8.3 and less than 16.2 ha) separated by a transmission line RoW. An access road would reduce the smaller patch by less than 0.5 ha at its western edge, as the site has already been bisected by a large clearcut prior to 2000. The larger patch, already subjected to selective cutting before 2000 (totaling 7.2 ha), would be bisected by the Project, resulting in two patches approximately 5.2 ha and 6.1 ha in size. Portions of the 6.1 ha patch have been selectively harvested in recent years, however this has not been quantified. The total loss of AHF #28 attributable to the Project is approximately 5.4 ha. The total loss of mature AHF habitat attributable to the Project is therefore 6.8 ha.



A third AHF site in the Assessment Area, affected by the proposed Grand Falls to Aroostook TCH Project, comprises two patches (5.1 and 15.0 ha) that have been subjected to selective cutting over much of the site since 1996, the year of available forest inventory data. The 5.1 ha patch east of a transmission line RoW will not be affected by construction, however 7.2 ha (previously affected by selective cutting since 1996) would be lost from the 15.0 ha site, leaving two patches of 2.0 and 5.8 ha.

The cumulative loss of AHF in these three sites due to these proposed TCH projects since the identification of the AHF in 1997 is 14.0 ha. The resulting patch size distribution is shown in Figure 6.6.3. Overall there will be a slight shift in the patch size distribution due to the future TCH projects, with a reduction in the 10-30 ha size class and increase in the 1-10 ha size class.

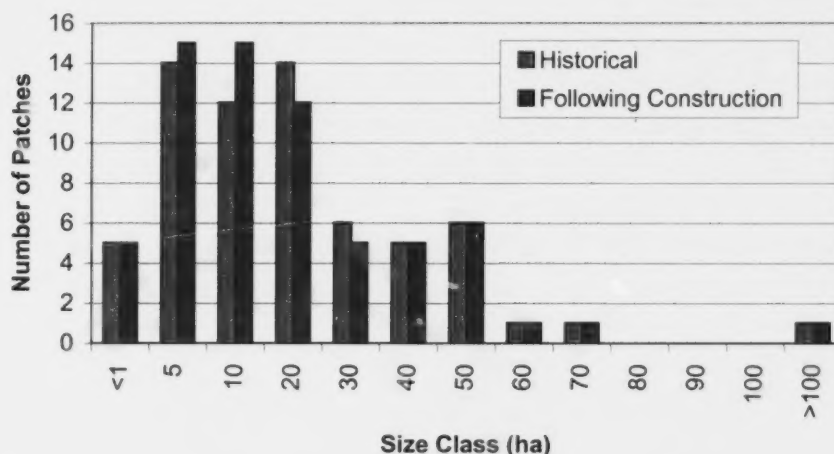


Figure 6.6.3 Change in AHF Patch Size Distribution due to Future TCH Projects (based on Betts 1999)

The existing Route 95 highway is located within the Meduxnekeag River watershed, and is considered a “hotspot” for AHF sites (MacDougall 1997). Two AHF sites are immediately adjacent to the existing highway (Richmond Corner and Highway 95 Woods). The two AHF sites (immediately south of the existing lanes) will not be directly affected by highway construction, as current plans are to position the new lanes north of the existing highway. The Meduxnekeag River bridge replacement project involving the replacement of the east bridge will not affect the nearby Woodstock-Meduxnekeag Bridge AHF site located west of the existing west bridge (Figure 2.1-D, Appendix B). There are no known AHF sites in the vicinity of the Woodstock to Pokiok and Pokiok to Longs Creek TCH projects.

The contributions of land use activities to the future loss of AHF habitat is difficult to predict, as land use plans are not available for the private land that makes up the AHF sites. Based on the recent losses of AHF attributable to other land uses between the 1980’s and 1996/2000 (Section 6.6.4.1), the loss of

AHF in the next 5 years is likely to be negligible for agriculture, quarries, and residential or other similar land uses. For forest harvesting, assuming a rate of 67.8 ha in 13 years continues, 26 ha could be lost within the AHF subset in the next 5 years.

6.6.4.3 Summary

Table 6.6.2 provides a summary of the known cumulative losses of AHF within the Assessment Area. Adding the historic losses (since the 1980's) to the losses associated with the future projects and activities results in an estimated total loss of 125.6 ha. This estimate accounts for projected losses due to forest harvesting in the future. Attempts by NTNB to convince private and freehold landowners to protect the known AHF areas from forestry have been generally unsuccessful, however a few landowners do intend to continue to minimize disturbance in their sites (J. Simpson, pers. comm.).

Table 6.6.2 Summary of Cumulative Environmental Effects on Area of AHF in the Assessment Area.

Project or Activity	Known Loss of AHF from 1980's to Present.	Projected Loss of AHF from Future Projects and Activities	Total loss of AHF Habitat
Perth-Andover to Woodstock TCH	N/A*	6.8 ha	6.8 ha
Grand Falls to Aroostook TCH	N/A	7.2 ha	7.2 ha
Existing TCH	0.3 ha	0	0.3 ha
Forest Resource Harvesting	67.8 ha	26 ha estimated	92.8 ha
Agriculture	2.5 ha	Negligible**	2.5 ha
Pits and Quarries	10.9 ha	Negligible	10.9 ha
Residential	5.4 ha	Negligible	5.4 ha
Totals	86.9 ha	39.0 ha	125.9 ha
Project Compensation			72.4 ha
Net loss of AHF in Assessment Area			53.7 ha

*N/A – not applicable

**based on the low rates of change observed from an analysis of the available data.

The protection of 72.4 ha of AHF of very high to high priority AHF not previously identified by MacDougall (1997) will contribute to conservation efforts, and should be considered more than adequate compensation for the loss of 6.8 ha of moderate priority sites by the Project. This AHF contains a large number of vascular plant species of conservation concern that would otherwise be at risk of future forest harvesting pressures. The two sites that make up the 72.4 ha of AHF are also relatively large patches, (48.8 and 23.6 ha respectively), and therefore also assures improved overall patch size distribution for AHF in the landscape. This compensation equals five times the loss of AHF attributable to both NBDOT Perth-Andover to Woodstock and Grand Falls to Aroostook TCH projects combined. These sites will be donated to the Province and recommended for formal environmental protection as a protected area.

Taking into account this compensation, the net cumulative loss of AHF habitat within the Assessment Area since the early 1980's is 53.7 ha, or 8.6%, but represents a reversal of cumulative trends that



without the NBDOT projects are estimated to be 110.9 ha. Based on the trends for AHF since the 1980's, it is likely that the previously unknown AHF sites that will be conserved due to the Project would otherwise be cut for forestry operations in the future, further future mitigating cumulative environmental effects. Also, as demonstrated by the identification of AHF not selected as suitable AHF and therefore not investigated by MacDougall (1997), the area of AHF is potentially much larger than previously documented (Section 5.5.4.4).

In consideration of planned mitigation and compensation, the Project is not anticipated to have any net adverse environmental effects on AHF or associated vascular plants of conservation concern that would overlap with those of other projects or activities.

6.6.5 Determination of Significance

Based on the above discussion, the contribution of the Project to cumulative environmental effects are, based on mitigation and compensation, considered positive in respect of the loss of AHF and associated vascular plant species of conservation concern. Cumulative environmental effects trends of other past, present, and future projects on AHF are lessened by the planned compensation. With Project compensation for loss of AHF, the net cumulative environmental effects of past, present and future projects are estimated to be 53.7 ha, or 8.6% of AHF (as determined by Betts (1999)) in the Assessment Area. As such, the cumulative environmental effects of the Project, in combination with other past, present, and future projects in the Assessment Area, are rated not significant.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.5 (Vegetation VEC), for the verification of the accuracy of the cumulative environmental effects analysis on Appalachian Hardwood Forest.

6.7 Cumulative Environmental Effects Analysis of Wetlands

6.7.1 Summary of Residual Environmental Effects of Project

The residual environmental effects of the Project on Wetlands, following mitigation, are the direct loss of approximately 22 ha of wetlands to construction. The wetland functional analysis of these wetlands found that only one wetland may be considered "significant". The direct environmental effects of the Project on the residual unaffected parts of the "significant" wetland are small and mitigation will be in place during Construction and Operation to mitigate potential environmental effects on wetland function, including additional monitoring, resulting in no net loss of wetland function. Wetland evaluations of the remaining wetlands determined that there would be no loss of wetland function on adjacent remnants (e.g., provision of habitat for wetland-dependent flora and fauna). Compensation measures planned for the Project totaling 66 ha (3:1 ratio) is expected to adequately compensate for the



direct losses and ensures that the Project will result in no net loss of wetland. Wetlands have been carried forward in the cumulative effects assessment due to Guideline requirements and regulatory concern, even though there will be no net loss of wetland habitat or function.

6.7.2 Identification of Issues and Selection of Indicators

The key issues for wetlands in the vicinity of the Project and surrounding areas are the loss of wetland function caused by either the direct reduction in wetland area from the conversion to other habitat (e.g., the filling in of wetlands for road construction and agriculture), or indirect environmental effects caused by adjacent land use practices (e.g., forestry, agriculture and road operations). The *New Brunswick Wetlands Conservation Policy* (NBDNRE and NBDELG 2002) applies to all wetlands greater than 1 ha in size, as does the *Watercourse and Wetland Alteration Regulation*. Although one of the goals of the provincial policy and the *Federal Policy on Wetland Conservation* is the maintenance of wetland function, the practical implementation and measurement of these losses is based on wetland area, especially for wetlands not considered provincially "significant".

The available data on wetlands do indicate historical trends that enable consideration of the cumulative environmental effects of other projects and activities of past, present and future projects that may overlap with those of the Project. Therefore wetland area has been chosen as the indicator for cumulative environmental effects on Wetlands.

The operation of the existing TCH, provincial and municipal roads, and future TCH has the potential to contribute to salinization of wetlands immediately adjacent to the roadways, as a result of salt application for winter safety. However, NBDOT is committed to developing and implementing best salt management practices in a continued effort to reduce the cumulative environmental effects of road salt on the environment. Data on historical trends in the salinization of wetlands in the assessment boundaries are not available. Since the improvement in the management of salt is expected to slow or perhaps reverse possible past operational effects of other roads, operational environmental effects of other projects and activities including salinization is not considered further in this cumulative environmental effects assessment.

Table 6.7.1 indicates which projects and activities may act cumulatively with the Project on Wetlands.



Table 6.7.1 Cumulative Environmental Effects Potential Interactions Matrix for Wetlands

Past, Present of Future Project or Activity	WETLAND VEC INDICATOR
	Loss of wetland area
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	✓
Saint-Léonard to Grand Falls TCH	✓
Perth-Andover By-Pass TCH	
Woodstock to Pokiok TCH	✓
Current and Future Highway Projects	
Grand Falls to Aroostook TCH	✓
Florenceville Bridge and Route 110 Interchange	
Lockhart Mill Interchange TCH	
Meduxnekeag River Bridge TCH	✓
Route 95 (Woodstock to Houlton)	✓
Pokiok to Longs Creek TCH	✓
Adjacent Land Uses	
Forest Resource Harvesting	✓
Agriculture	✓
Hydroelectric Power Generation	✓
Residential	✓
Commercial	✓
Industrial	✓
Hunting	
Fishing	
Planned Development Along Proposed TCH	
Tobique Truck Stop (Perth-Andover)	
Grand Falls Big Stop	
Other Planned Development	
New Brunswick Potato Museum/Learning Center on Route 110	
Wakefield Salmon Hatchery	
Woodstock Wastewater Treatment Plant	



6.7.3 Assessment Boundaries

The spatial boundaries for cumulative environmental effects assessment on Wetlands are based on the NBDNR wetland and forest inventory information compiled for the assessment of three current and future TCH projects. These include the Project, the Grand Falls to Aroostook TCH Project, and the Pokiok to Longs Creek TCH Project (Figure 6.7.1). These data provide a good representation of the diversity of wetlands potentially affected by the TCH projects and to some considerable extent the activities identified in Table 6.7.1 above that are in proximity to these projects. A summary of wetland change based on aerial photos from the 1930's to the 1980's was completed for agricultural areas of Carleton County (R. Caposi, pers. comm.). Those data are helpful for benchmarking cumulative environmental effects but are limited to Carleton County.

Temporal boundaries for the cumulative environmental effects assessment of wetlands are from the 1930's to present for historic trends and uses recent NBDNR Wetland and Forest Inventory Data from 1994 to 2000 as current data. Wetland and Forest Inventory Data for the different TCH projects are based on different years of recent aerial photography (Table 6.7.2). Temporal boundaries for the cumulative environmental effects assessment of future projects and activities include the next five years, beyond which forecasting is not reliable.

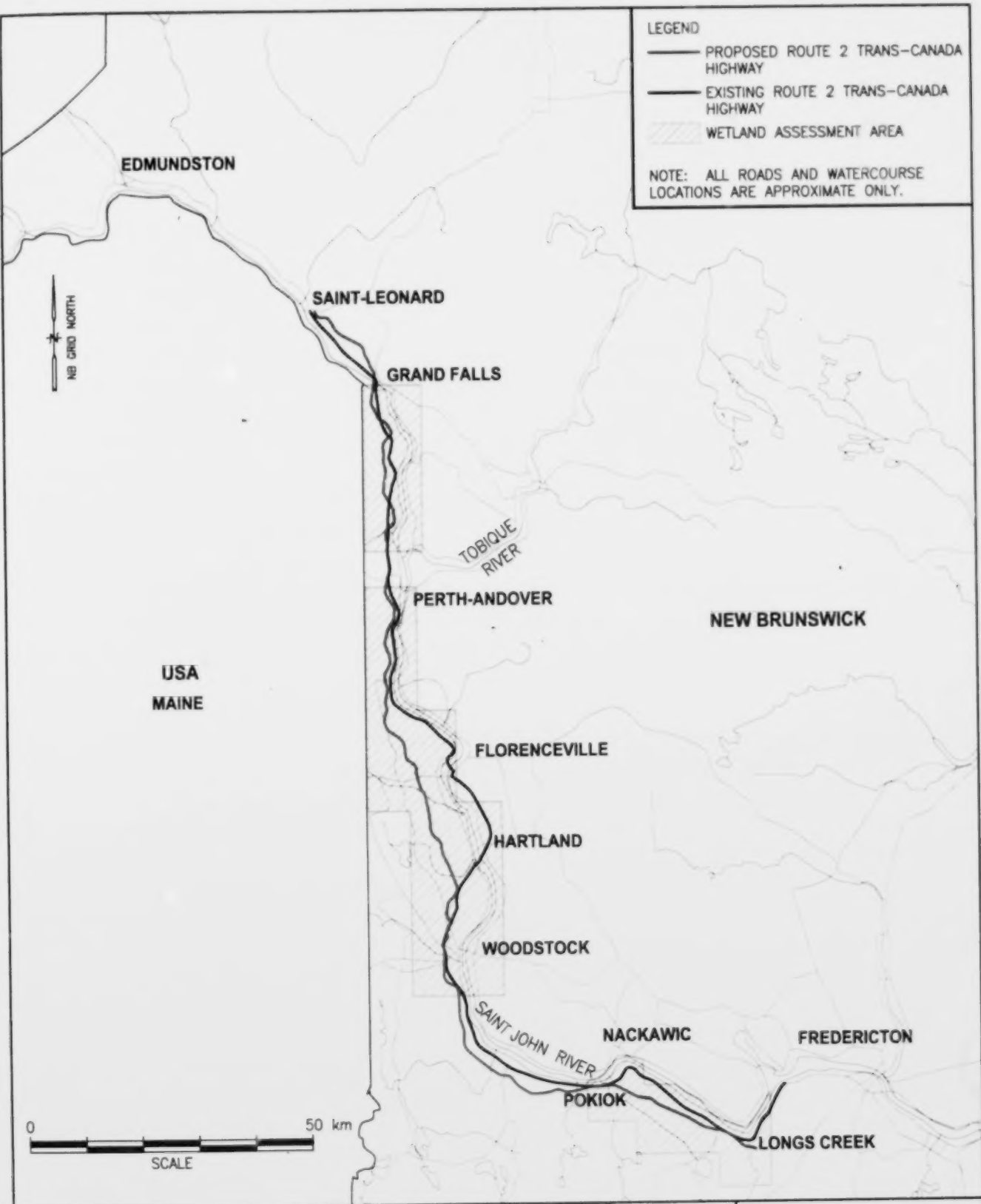
Table 6.7.2 Years of Aerial Photography used as the Basis of the Wetland and Forest Inventory Databases

TCH Project	Year(s) of available aerial photography
Grand Falls to Aroostook	1996
Perth-Andover to Woodstock	1996 (north end) and 2000 (south end)
Pokiok to Longs Creek	1999 (north end) and 1994 (south end)





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SPATIAL BOUNDARIES FOR THE CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT OF WETLANDS

Date:	2004 04 15	Scale:	AS SHOWN
Job No.:	14677	Fig. No.:	6.7.1



Jacques Whitford
Consulting Engineers
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6.7.4 Wetland Area

6.7.4.1 Historic Trends and Existing Conditions

Aerial photos are available for New Brunswick from the 1930's. Analysis of aerial photos from the 30's to the 80's in the agricultural-dominated Carleton County indicated that there had been approximately a 4% net loss of wetlands (R. Caposi, pers. comm.). The loss of wetlands in this area of the Province is mostly due to agriculture, including the ditching of wetlands to drain them. This loss relates mostly to wetlands not associated with watercourses. There has been little creation of wetlands except for those resulting from beaver activity. However, Ducks Unlimited has a number of past wetland projects that at least partially offset historic losses of wetlands. Examples of DU sites in the vicinity of the Project include Carlisle Lake and Tweedie Lake Flowage. Two sites are also located in the vicinity of the Pokiok to Longs Creek TCH project (Pokiok Deadwater and Prince William).

Although there has also likely been losses of floodplain wetlands along the Saint John River due to hydroelectric dam construction in the 60's, the analysis by R. Caposi (pers. comm.) did not focus on those losses. There is no known summary of losses of wetlands from hydroelectric dams.

Based on current available data from air photo interpretation (1996/2000), there are approximately 394 wetland complexes totaling 1,863 ha, in the Assessment Area for the Project. Analysis of the Assessment Area for changes to wetlands associated with other projects indicates that 52.5 ha of wetland habitat, within 91 wetland complexes or singular wetlands, are within 30 m of a provincial, local or forest road. Seventy-three of these wetlands are immediately adjacent, suggesting that road construction may have had direct environmental effects on wetlands. However in some cases roadways have resulted in the creation of open water wetlands from impeded drainage and beaver activity.

In the vicinity of Grand Falls to Aroostook project, there are approximately 69 wetland complexes totaling 300 ha based on 1996 data. Analysis of the proximal portion of the Assessment Area for changes to wetlands indicates that 16.8 ha of wetland habitat, within 28 wetland complexes or singular wetlands, are within 30 m of a provincial, local or forest road. Thirteen wetlands are immediately adjacent, suggesting that road construction may have had direct environmental effects on wetlands.

In the vicinity of Pokiok to Longs Creek there are approximately 140 wetland complexes totaling 2,212 ha based on 1996/1999 data. There is a large proportion of wetland habitat south of the TCH Project, associated with the Pokiok Stream. A total of 27.5 ha of wetland habitat, within 51 wetland complexes or singular wetlands, are within 30 m of a provincial, local or forest road, and 38 wetlands are immediately adjacent.

Table 6.7.3 summarizes this information and for the Assessment Area overall.



Table 6.7.3 Summary of Wetland Data

	Perth-Andover to Woodstock Area	Grand Falls to Aroostook Area	Pokiok to Longs Creek Area	Total
Total number of wetland complexes	394	69	134	597
Total area of wetland (ha)	1,863	300	2,212	4,375
Number of wetlands intersected by roads*	73	13	38	124
Number of wetlands within 30 m of roads*	91	28	51	170
Area of wetland habitat within 30 m roads* (ha).	52.5	16.8	27.5	96.8
* includes provincial, local and forest roads.				

The existing TCH and some of the provincial and municipal roads have likely had at least some direct environmental effects on wetlands located adjacent to these roads. Construction of these roads may have contributed to habitat loss, reduced habitat quality and loss of wetland function. For example, of the 24 wetlands and wetland complexes located within 30 m of the proposed Project RoW, four (WL12, WL16, WL20, WL24) have been bisected by other roads, including one (WL24) bisected by the existing TCH, which will be twinned as part of the Project.

The Perth-Andover By-pass TCH project is mostly the twinning of the existing road, and does not affect any wetland habitat. During the route selection for the Saint-Léonard to Grand Falls and Woodstock to Pokiok TCH projects, known wetlands were avoided. No concerns regarding wetlands were expressed by Environment Canada or NBDNR during the environmental review of these projects (NBDOT 1998b, c, 1999a, b).

6.7.4.2 Project Interactions with Other Future Projects and Activities

Wetlands are one of the constraints that NBDOT planners try to avoid (or minimize the environmental effects to the extent possible) when selecting alignment corridors for highways (Section 2.2.2). During the route selection for the Grand Falls to Aroostook and Pokiok to Longs Creek TCH projects, most wetlands have been avoided, or will likely have minor indirect environmental effects. There will be a direct loss of less than 3 ha (2.1 ha for Pokiok to Longs Creek and 0.85 ha for Grand Falls to Aroostook) of wetland habitat on those two projects. None of these wetlands were considered "significant", following wetland evaluations (JWEL 2003b; 2004).

The Route 95 (Woodstock to Houlton) twinning project (currently in the planning stages) has the potential to affect approximately 1 ha of a wetland surrounding Morrison Lake, based on available wetland information. The Florenceville Bridge and Route 110 Interchange is not expected to affect any wetlands.

Adjacent land uses that may in the past have had, or may in the future have, environmental effects that act cumulatively with those of the Project include forest resource harvesting, agriculture, hydroelectric



power generation, residential, commercial and industrial development. There is a potential for any of these activities to contribute to losses of wetland area and degradation of wetland quality. Only seven wetlands (WL 1, 12, 19, 20, 21, 23 and 24) within 30 m of Project RoW are also in close proximity to agricultural land and/or other occupied land. A number of the wetlands have also likely been subjected to some degree of cutting in adjacent forestland. The functional assessment of each of the wetlands accounted for these other land uses.

Only one wetland crossed by the Project (WL3) is considered "significant", following wetland evaluations (Section 5.6.4.3), however would not be considered a "provincially significant" wetland (NBDNRE and NBDELG 2002). This wetland is controlled by a man-made structure that created the open water habitat. Forest harvesting is the only past activity identified as having some environmental effects on this wetland, however the environmental effects have not appeared to have affected wetland function of this wetland. There are no residual environmental effects of the Project on this wetland, following mitigation and compensation.

The use of provincial and federal mitigative practices, including managing activities within or leaving 30 m buffer zones (as per the *Watercourse and Wetland Alteration Regulation of the Clean Water Act*) adjacent to wetlands, during future forest harvesting, agricultural activities, and land development will preserve wetland area and minimize degradation of wetland quality. Where wetland losses are considered necessary for a project, wetland compensation would likely be required as part of conditions of approval of permits. Future projects registerable under the *NB Environmental Impact Assessment Regulation* that will necessitate the loss of wetlands would also require compensation if the project is permitted to proceed.

6.7.4.3 Summary

Table 6.7.4 summarizes the known contributions of future projects to loss of wetland area.

Table 6.7.4 Summary of Wetland Loss from Current and Future Projects

Project	Wetland Loss Area (ha)
Grand Falls to Aroostook TCH	0.85
Perth-Andover to Woodstock TCH	22
Route 95 (Woodstock to Houlton)	1.0 (est.)
Meduxnekeag River Bridge TCH	Negligible
Pokiok to Longs Creek TCH	2.1
Total	25.95

Information on a representative portion of the spatial boundaries of this cumulative environmental effects assessment suggests the historic loss wetlands from the 30's to the 80's was approximately 4%. Another 96.8 ha of wetland habitat are located within 30 m of existing roads in the Assessment Area.



Overall, the historic loss may be considered significant but cannot be quantified due to the lack of data. The total projected loss of wetland habitat from the various current and future TCH projects is 25.95 ha. However, all of this loss has or will require compensation at a 3:1 ratio, resulting in an equivalent of 78 ha of wetland area replaced or improved, as will be determined through consultation with NBDNR and CWS. Therefore, the contribution of the Project to cumulative environmental effects that may already be significant will be fully mitigated and compensated.

6.7.5 Determination of Significance

Based on the above discussion, the contribution of the Project to cumulative environmental effects are fully mitigated and compensated. Cumulative environmental effects trends of other past, present, and future projects on wetlands, although potentially significant are lessened by the planned Project-related compensation.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.6 (Wetlands VEC), for the verification of the accuracy of the cumulative environmental effects analysis of wetlands.

6.8 Cumulative Environmental Effects Analysis of Moose and Moose Habitat

6.8.1 Summary of Residual Environmental Effects of Project

The residual environmental effects of the Project on Moose and Moose Habitat, taking into account mitigation, are the fragmentation of habitat due to the use of fencing and wildlife crossing structures, and some residual mortality due to vehicle collisions and increased hunter access. However, the environmental assessment of the Project has concluded that the residual environmental effects of the Project are not significant.

Mitigation for moose includes route selection and refinement of the highway, and the use of wildlife fencing and crossings. The highway was realigned in the vicinity of Dryer road to Raymond Road in response to public concern that this was an area of high use by moose. This was confirmed during aerial surveys and during field surveys for migratory birds. NBDOT is also working closely with NBDNR biologists to select appropriate locations for fencing and wildlife crossings based on the results of aerial surveys conducted during early 2003 and 2004, taking into account recent guidelines developed by NBDNR. Experience from road construction north of Saint-Léonard is that routing highways through areas of older uncut forests may result in cutting of adjacent habitats by the woodlot owners, due to the opportunistic access. The result is the attraction of moose to the edge of the RoW for browse, where their presence was not previously reported. Given the changes in the landscape that are occurring and are likely to occur in the near and distant future due to forestry practices and the highway construction



activities themselves, NBDNR has recommended that the details of where to locate corridors and fencing be developed over the course of Project development, where possible. Corridors, however, will have to be selected relatively early in the design process. Following construction, NBDOT is committed to conducting follow-up to determine the use of the surrounding habitat by moose, to verify the environmental assessment conclusions and evaluate the effectiveness of planned mitigation.

6.8.2 Identification of Issues and Selection of Indicators

The key issues for moose in the vicinity of the Project and surrounding areas are moose mortality and fragmentation of their habitat. Moose winter foraging habitat is generally not limiting in the ever-changing forested environment where regenerating clearcuts provide a shifting food source, and moose movement is also generally not limited in the existing environment. Another important related issue is public safety. In this part of the Province, the interaction of moose and the travelling public results in a high number of deaths every year along the existing TCH highway, for both people and moose. Information collected on moose during the route selection stage as well as more recent aerial surveys conducted for the environmental assessment have demonstrated that there are no feasible routes for the new highway that will completely avoid all areas inhabited by moose at some time of the year. The key is the mitigation of moose mortality, usually in the form of fencing, which necessitates the use of crossing structures to reduce the fragmentation of habitat and facilitate the seasonal movements of moose. Moose population itself is selected as the indicator for Moose and Moose Habitat, based on the available data on moose in the area.

Table 6.8.1 summarizes those projects and activities that may act cumulatively with the Project on Moose and Moose Habitat. The other TCH projects located in areas with a high incidence of moose activity and resultant highway collisions include Saint-Léonard to Grand Falls, and Grand Falls to Aroostook. Forest harvesting has an influence on moose distribution due to the resultant changes in forest as cover and a food source, while hunting (including licensed hunts, poaching, and the Aboriginal hunt) contributes to mortality.

Table 6.8.1 Cumulative Environmental Effects Potential Interactions Matrix for Moose and Moose Habitat

Past, Present or Future Project or Activity	MOOSE AND MOOSE HABITAT VEC INDICATOR
	Moose Population
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	
Saint-Léonard to Grand Falls TCH	
Perth-Andover By-Pass TCH	
Woodstock to Pokiok TCH	



Table 6.8.1 Cumulative Environmental Effects Potential Interactions Matrix for Moose and Moose Habitat

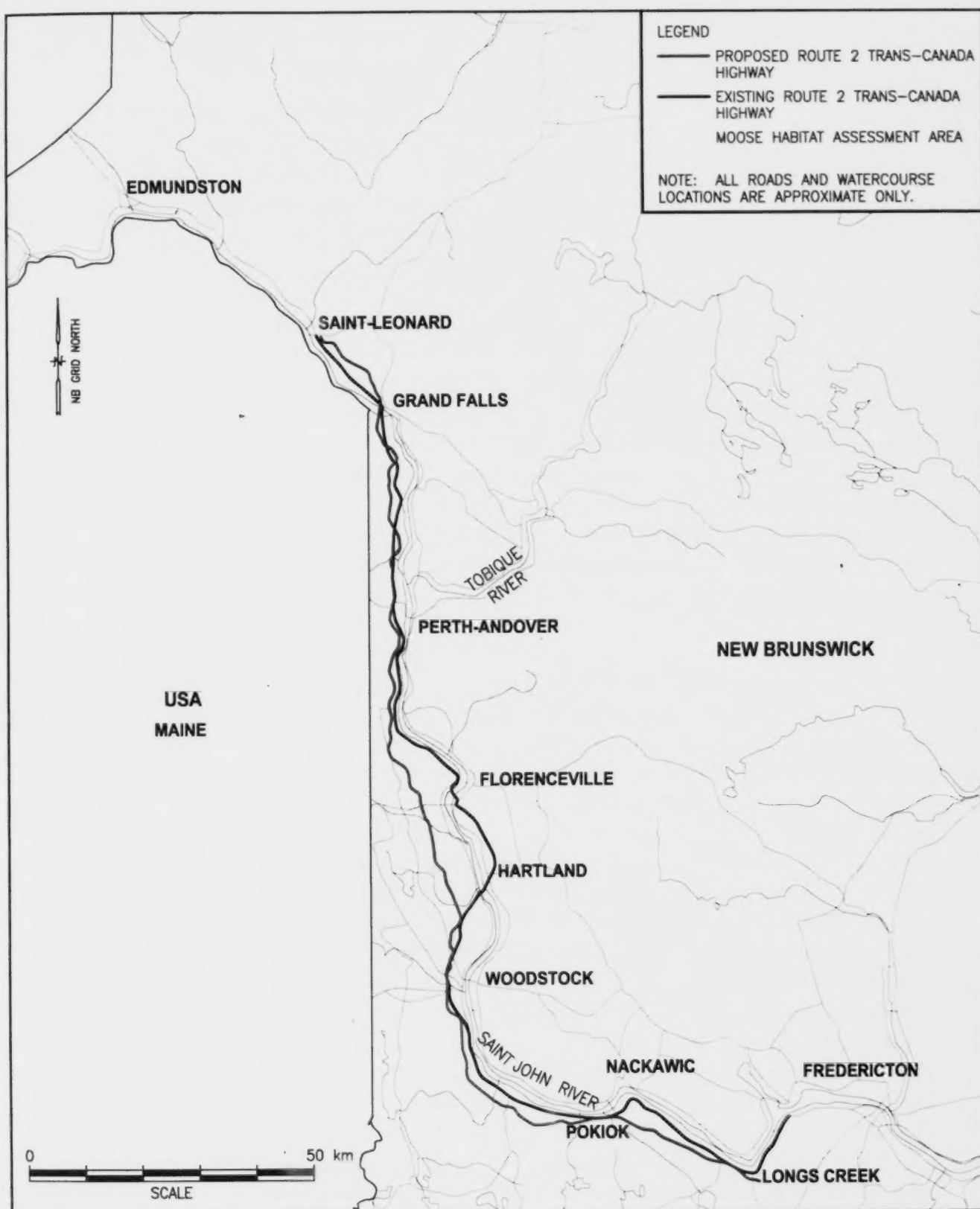
Past, Present or Future Project or Activity	MOOSE AND MOOSE HABITAT VEC INDICATOR
	Moose Population
Current and Future Highway Projects	
Grand Falls to Aroostook TCH	✓
Florenceville Bridge and Route 110 Interchange	
Lockhart Mill Interchange TCH	
Meduxnekeag River Bridge TCH	
Route 95 (Woodstock to Houlton)	
Pokiok to Longs Creek TCH	
Adjacent Land Uses	
Forest Resource Harvesting	✓
Agriculture	✓
Hydroelectric Power Generation	
Residential	
Commercial	
Industrial	
Hunting	✓
Fishing	
Planned Development Along Proposed TCH	
Tobique Truck Stop (Perth-Andover)	
Grand Falls Big Stop	
Other Planned Development	
New Brunswick Potato Museum/Learning Center on Route 110	
Wakefield Salmon Hatchery	
Woodstock Wastewater Treatment Plant	

6.8.3 Assessment Boundaries

The spatial boundaries for cumulative environmental effects assessment of moose populations is NBDNR Wildlife Management Area #10 (WMA 10), which encompasses the two future highway projects in the areas of high incidents of vehicular collisions with moose (Figure 6.8.1). This area is reflective of the main areas where moose interact with the Project and other projects, in this region of the Province. Data on moose population are based on Wildlife Management Areas, however data for New Brunswick are provided for context.

Temporal boundaries for the cumulative environmental effects assessment of moose populations include the period from 1960 to the present based on available hunting statistics. Temporal boundaries for the cumulative environmental effects assessment of future projects and activities include the next five years, beyond which forecasting is not reliable.





**SPATIAL BOUNDARIES FOR THE CUMULATIVE
ENVIRONMENTAL EFFECTS ASSESSMENT OF
MOOSE HABITAT**

Date:
2004 04 15

Job No.:
14677

Scale:
AS SHOWN

Fig. No.:
6.8.1



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6.8.4 Moose Populations

6.8.4.1 Historic Trends and Existing Conditions

Trends in the New Brunswick moose population are derived mainly from hunting statistics. There is little information on the size of the moose population prior to 1960. As settlement in New Brunswick increased, it is likely that moose were heavily harvested. Moose harvesting was first regulated in the Province in the late 1880's. Between 1936 and 1959, the moose hunting season was closed in New Brunswick due to overexploitation. In 1960, the New Brunswick moose population was estimated to be between 3,000 and 5,000 animals (K. Craig, pers. comm.). From 1976 to 2000, the number of moose harvested and the hunter success rates have increased (NBDNR undated). By 1999, the moose population in the Province was estimated to be between 21,000 and 23,000 (K. Craig, pers. comm.). The number of registered moose kills has increased from 174 in 1960 to 2,573 in 2001. The 2002 registered resident moose kill for WMA 10 was 65 moose, compared with 2,020 for the Province, or 3.2% of the provincial registered kill (NBDNR 2003b). The 2003 quota for WMA 10, however was reduced from 111 in 2002 to only 10 in 2003 due to other mortality factors (NBDNR 2003b; N. Prentice, pers. comm.). From 2000 to 2002, hunting success rates have dropped (NBDNR undated). NBDNR has indicated that the New Brunswick moose population has dropped to 21,000 in 2003. However, an accurate assessment of the moose population is difficult due to the unregulated Aboriginal harvest that commenced in 1999 after the Marshall ruling.

Prior to 1999, unlicensed, non-Aboriginal hunting was estimated to harvest approximately 200 moose annually, province-wide (K. Craig, pers. comm.). Although detailed statistics on unlicensed hunting are not available, it is likely that 10 to 15 moose are taken this way annually from WMA 10 (K. Craig, pers. comm.). Most of the Crown land in this WMA is located east of the Saint John River, and is where much of the hunting pressure (both registered and Aboriginal) in this zone occurs (N. Prentice, pers. comm.).

The existing TCH and some of the local highways and roads contribute to the fragmentation of the landscape and the operation of these roads represent sources of moose collisions. While this road network does not impede the movement of moose in the landscape, it does increase the probability of collisions. Collision rates on the existing TCH where it is close to the Saint John River are relatively low, and collision rates on local highways and roads are not particularly high due to lower speed limits. Local users may also be more aware of the local potential for collisions. Motor vehicle collision statistics from 1995 to 2000 indicate an average of approximately 250 collisions per year Province-wide (NBDOT 2004), or approximately 1.2% of the current estimate of approximately 21,000 moose in the Province. In contrast, the existing TCH from Grand Falls to Aroostook has one of the highest collision rates in the Province (N. Prentice, pers. comm.). As is the case for most of the existing 2-lane TCH, there is no wildlife fence on this stretch of road. NBDNR has even removed suitable browse where



Crown land is immediately adjacent the TCH, so as to not otherwise attract moose to the edge of the highway.

Aerial surveys conducted in 2003 and 2004 for the Perth-Andover to Woodstock and Grand Falls to Aroostook TCH projects reaffirmed that moose activity in the vicinity of the Perth-Andover overpass is low, and did not warrant mitigation measures for moose.

Adjacent land uses that may have in the past had environmental effects on moose populations include forest resource harvesting and agriculture. Adjacent land use in agriculture development has added to the total cleared land, and resulted in a loss of suitable habitat for moose. Cleared forest suitable for cultivation is often replaced with agricultural fields in this area of the Province. However, many of the more significant wildlife areas within the Assessment Area and just beyond (e.g., Williamstown Lake Wetlands and Clarke Bog), are not suitable for agriculture or have some degree of protection through acts and regulations. These are likely high use areas for moose. In some of the more extensive remaining areas of forest cover, such as in the vicinity of Strong Corner, the low lying wetland areas with surrounding forest habitat are unlikely to be converted to agricultural land. Some landowners have interests other than forestry and agriculture (i.e., hunting and trapping), that will also help to ensure the persistence of forest habitat in the region. As noted in Section 5.7.5.2.1, efforts are made to manage the forest at a sustainable level, and to have a mixture of stand ages.

6.8.4.2 Project Interactions with Other Future Projects and Activities

Of the current and future highway projects, only the Project and the Grand Falls to Aroostook TCH project are likely to have similar environmental effects as described for the operation of the existing TCH and local highways and roads. This is because of the concentration of moose in those as opposed to other areas. Planning and design for the Grand Falls to Aroostook TCH project will follow similar mitigating measures and design standards as are being implemented for the Project. Moose fencing and where possible wildlife corridors will play an important role in reducing collisions in this area.

The areas of highest potential for vehicle collisions with moose are where moose habitat is found on either side of the highways, usually along natural corridors such as river valleys. Fencing and wildlife crossing structures will be used together to keep moose off the highway and direct them through the crossing structures. These crossing structures most often will be associated with watercourse crossings, however some will be associated with severed property access roads. These could have a reduced use by moose if they become highly used by snowmobiles or ATVs. In some cases planned underpasses for local roads may provide a suitable corridor, depending on traffic use.

The increased access, attributable to the future TCH projects, to some areas frequented by moose, but currently relatively remote, will likely result in increased hunting pressure. NBDNR believes, however,



that the moose population in this area of WMA 10 can handle the increased hunting pressure (N. Prentice, pers. comm.).

The increased forest harvesting that can accompany highway development will in time, as clearcuts regenerate, increase the available browse. In areas of planned fencing, this will not likely be an issue, however, natural regeneration following clearing in areas that did not demonstrate high moose usage during the aerial surveys, and where no fencing is recommended, could result in the attraction of moose. The use by moose of these regenerating areas could possibly be discouraged by implementing intensive silvicultural practices (N. Prentice, pers. comm.). Incentive programs are apparently currently in place that private landowners can access to offset the associated costs of this mitigation.

Based on the distribution of moose observed during the 2003 aerial survey, specifically the separation of moose between the two projects (*i.e.*, the limited moose activity observed between Aroostook and Perth-Andover), there may not be very much interaction between moose populations in the vicinity of the two projects. Similarly, moose activity was not observed in the highly fragmented agricultural area of the Project, south of Little Presque Isle River. Therefore, the potential environmental effects of the other TCH projects will not likely act cumulatively with those of the Project. The planned developments within the spatial boundaries will not likely have a measurable effect on moose populations, given the size and location of the developments, and planned mitigation.

6.8.4.3 Summary

The management objective for both future TCH projects where moose have been identified as a concern is a net reduction in mortality of moose from vehicle collisions. This will be achieved with the planned mitigation (*e.g.*, wildlife fences and crossing structures) and follow-up. The selection and placement of fences and structures are being developed in consultation with NBDNR biologists. Although improved access will improve hunter access to western areas of WMA 10, NBDNR believes that this area can handle the likely increased hunting pressure. NBDNR will continue to manage the regulated hunt based on hunter success and other mortality factors.

6.8.5 Determination of Significance

Based on the above discussion, the Project residual environmental effects will not act substantively in combination with those of other past, present and future projects to such an extent as to cause an exceedance of the residual environmental effects rating criteria for moose, defined in Section 5.7.3. Therefore, the cumulative environmental effects of the Project in consideration of planned mitigation, in combination with other past, present, and future projects, is rated not significant.



There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.7 (Wildlife VEC), for the verification of the accuracy of the cumulative environmental effects analysis of moose and moose habitat.

6.9 Cumulative Environmental Effects Analysis of Migratory Birds of Special Conservation Concern

6.9.1 Summary of Residual Environmental Effects of Project

The Project residual environmental effects on Migratory Birds of Special Conservation Concern, taking into account mitigation, are the loss of an estimated 735 ha of forest and 74 ha of undeveloped land (including 22 ha of wetland), and the fragmentation of habitat. The assessment of environmental effects of the Project has concluded that these residual environmental effects are not significant in consideration of planned mitigation. Agricultural land affected by the Project (223 ha) was found to have few migratory birds of special conservation concern, and few of the wetland "target" bird species (as identified by CWS) were directly associated with the wetland habitats. Key mitigation to reduce the potential environmental effects of the Project on Migratory Birds of Special Conservation Concern include limiting the area of critical habitat required for the Project to the extent possible, and conducting most clearing outside the breeding season of migratory birds.

6.9.2 Identification of Issues and Selection of Indicators

The key issues that have been identified with respect to Migratory Birds of Special Conservation concern are habitat loss and fragmentation. More specifically, the three important habitat types that have been identified by CWS and were targeted during the collection of baseline information on birds for this assessment were mature forest, wetland and grassland/agricultural habitats. Particular importance was given to "target" bird species prioritized by CWS and associated with these three habitat types. Few target species associated with wetland and grassland/agricultural habitats were encountered during field surveys. Several target species associated with mature forest habitat were recorded, and of the three habitats, the loss of mature forest (estimated at 206 ha) affected the greatest number of target species of these three target habitats.

The "target" species of mature forest recorded during the field surveys include the Great Crested Flycatcher, Purple Finch, Wood Thrush, and Canada Warbler. Wood Thrush is designated by NBDNR as a "May Be At Risk" species, Great Crested Flycatcher and Purple Finch are considered "Sensitive", however Canada Warbler is considered "Secure". Of these four target species, only Wood Thrush demonstrated a requirement for mature forest in the Project Assessment Area, and is therefore selected as the focus of the cumulative environmental effects assessment. Great Crested Flycatcher, Canada Warbler and Purple Finch were all recorded in a variety of habitat types and as discussed in the



environmental assessment of the Project (Sections 5.7.4.1.1 and 5.7.5.1.1) are likely to be relatively abundant in the Assessment Area. Great Crested Flycatcher are secondary cavity nesters, and therefore require old woodpecker cavities to nest, which are most likely to be found in mature forest. In the Assessment Area however, they were found in a variety of forest types and ages, including forested wetland habitats. Wood Thrush was also found in mostly mature forests, but also within younger forest. The indicators selected for the assessment of cumulative environmental effects are the *loss and fragmentation of mature forest habitat*, with respect to the Migratory Birds of Special Conservation Concern dependent on this habitat. Evaluation of these indicators is focused on Wood Thrush because it is a CWS "target" species that is demonstrated to use mature forest habitat in the Project Assessment Area.

Bird mortality during construction of the Project and all other future highway projects recently or currently under assessment should be sufficiently reduced by the planned mitigation. Therefore this issue is not carried forward in the assessment of cumulative environmental effects.

Table 6.9.1 indicates which projects and activities that may act cumulatively with the Project on Migratory Birds of Special Conservation Status.

Table 6.9.1 Cumulative Environmental Effects Potential Interactions Matrix for Migratory Birds of Special Conservation Concern

Past, Present or Future Project or Activity	MIGRATORY BIRDS OF SPECIAL CONSERVATION STATUS VEC INDICATORS	
	Mature Forest Habitat Loss	Mature Forest Habitat Fragmentation
Existing TCH and Other Provincial and Municipal Roads		
Saint-Léonard to Grand Falls TCH		
Perth-Andover By-Pass TCH		
Woodstock to Pokiok TCH		
Current and Future Highway Projects		
Grand Falls to Aroostook TCH	✓	✓
Florenceville Bridge and Route 110 Interchange	✓	✓
Lockhart Mill Interchange TCH		
Meduxnekeag River Bridge TCH		
Route 95 (Woodstock to Houlton)	✓	✓
Pokiok to Longs Creek TCH	✓	✓
Adjacent Land Uses		
Forest Resource Harvesting	✓	✓
Agriculture	✓	✓
Hydroelectric Power Generation		
Residential		
Commercial		
Industrial		
Hunting		
Fishing		
Planned Development Along Proposed TCH		
Tobique Truck Stop (Perth-Andover)		
Grand Falls Big Stop		



Table 6.9.1 Cumulative Environmental Effects Potential Interactions Matrix for Migratory Birds of Special Conservation Concern

Past, Present or Future Project or Activity	MIGRATORY BIRDS OF SPECIAL CONSERVATION STATUS VEC INDICATORS	
	Mature Forest Habitat Loss	Mature Forest Habitat Fragmentation
Other Planned Development		
New Brunswick Potato Museum/Learning Center on Route 110		
Wakefield Salmon Hatchery		
Woodstock Wastewater Treatment Plant		

6.9.3 Assessment Boundaries

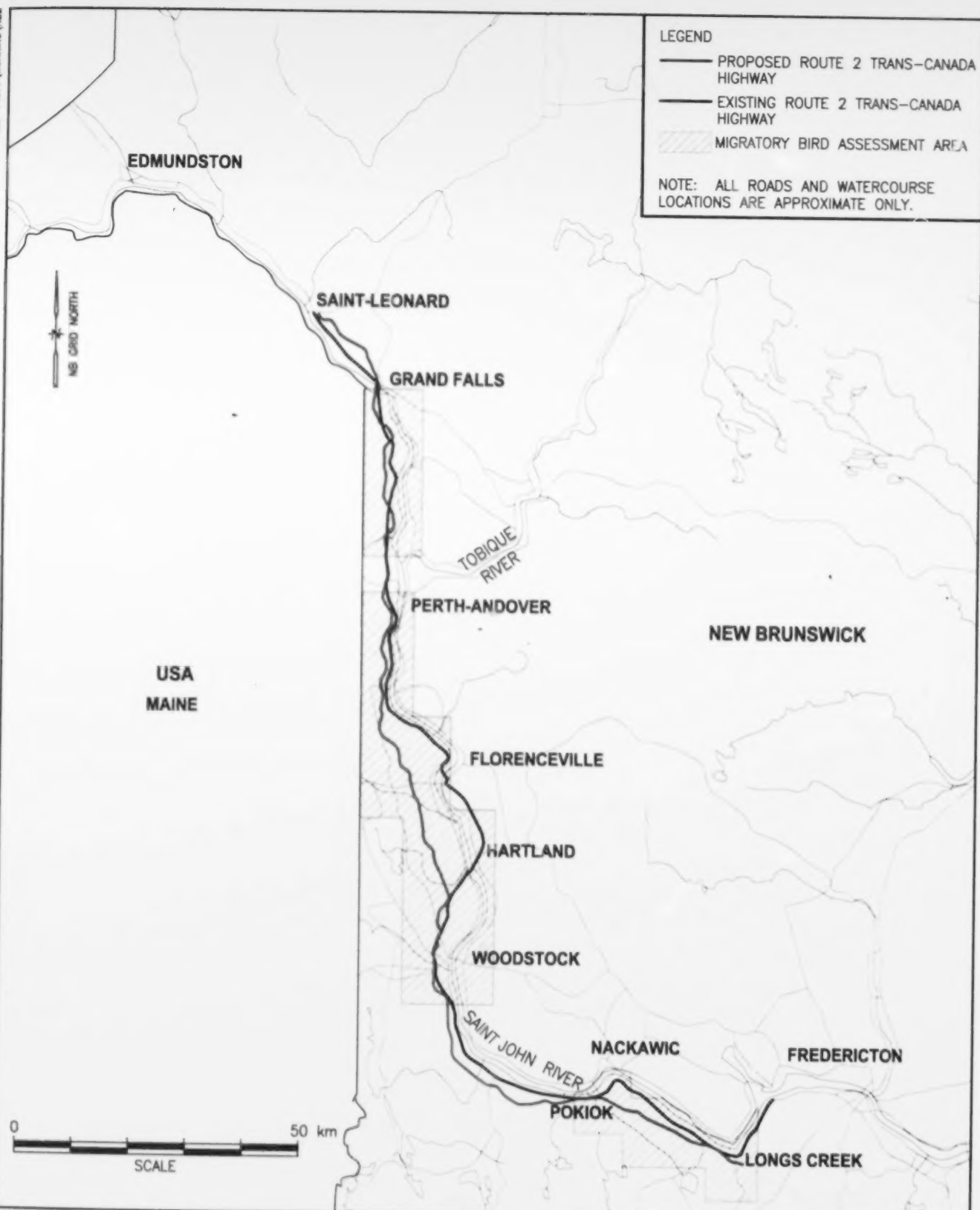
The spatial boundaries of the Assessment Area for cumulative environmental effects assessment of mature forest migratory birds are based on the NBDNR forest inventory information compiled for the assessment of three current and future TCH projects. These include the Project, the Grand Falls to Aroostook TCH Project, and the Pokiok to Longs Creek TCH Project (Figure 6.9.1). The database for these three projects provides a good representation of the diversity of habitat potentially affected by the projects and activities identified in Table 6.9.1 above.

Temporal boundaries for the cumulative environmental effects assessment of mature forest migratory birds include the period from 1968 to the present based on available Breeding Bird Survey information. With respect to mature forest habitat, temporal boundaries for the past and present are changes between 1984 to 1996/2000, based on the available forest inventory data. Temporal boundaries for the cumulative environmental effects assessment of future projects and activities include the next five years, beyond which forecasting is not reliable.

6.9.4 Mature Forest Migratory Bird Habitat

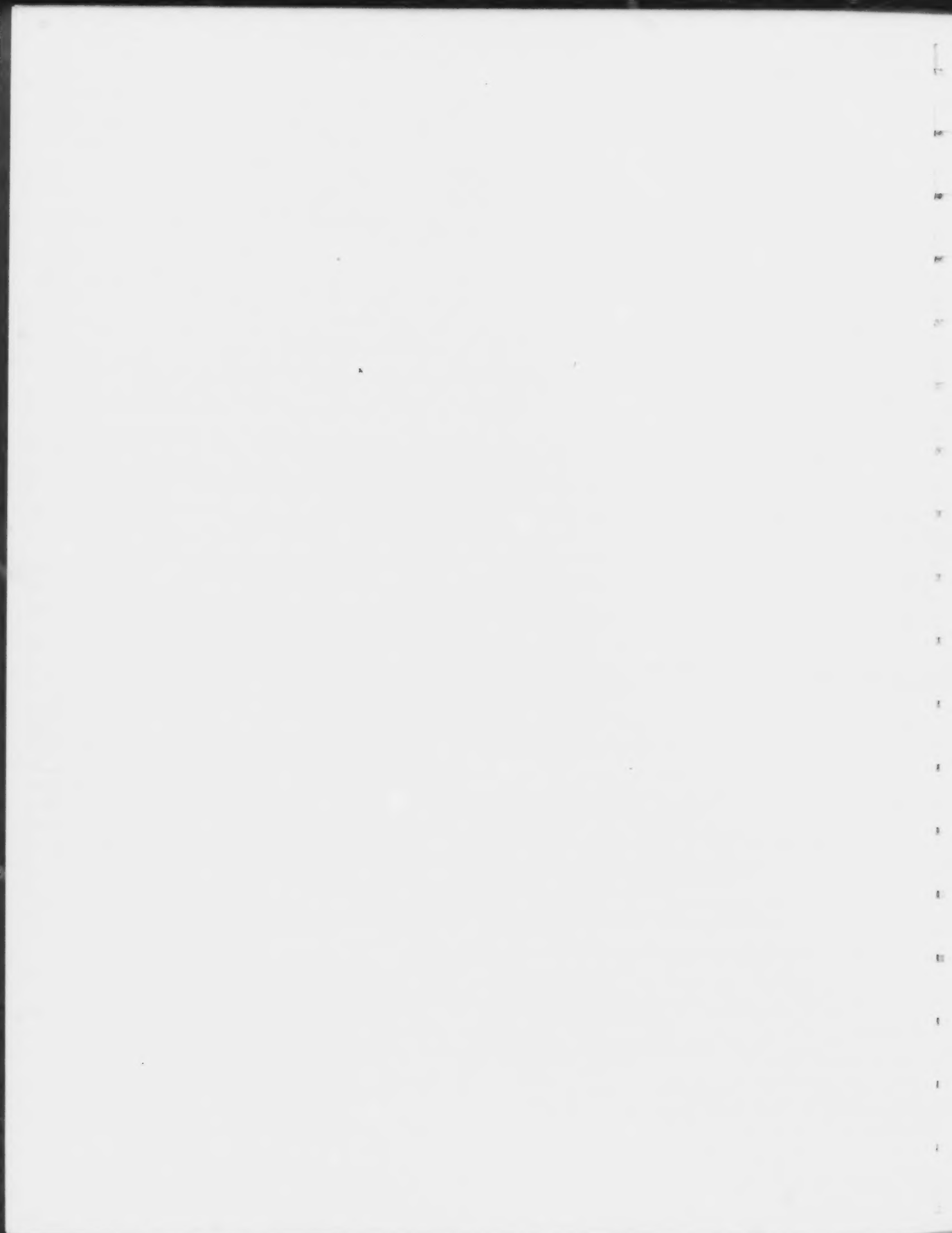
6.9.4.1 Historic Trends and Existing Conditions

Published information on historical trends for migratory bird populations is available for New Brunswick (Downes *et al.* 2003) but was not found specifically for the central Saint John River valley. The greatest effects on migratory bird populations in the Maritimes since European settlement are related to habitat alteration (Erskine 1992). Much of the land in western New Brunswick was cleared in the 19th century and early 20th century for settlement, agriculture and forestry. In the 1930's and 1940's, much of these cleared lands were allowed to reforest. Birds that depend on mature, closed, mixedwood forests were likely more abundant in New Brunswick prior to settlement and those characteristic of younger, open, coniferous forests are likely more abundant presently than prior to settlement (Erskine 1992). Erskine (1992) states that "...few forest bird species have disappeared from or appeared in the Maritimes as a result of forest changes over recent centuries."



SPATIAL BOUNDARIES FOR THE CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT OF MIGRATORY BIRDS OF SPECIAL CONSERVATION CONCERN	Date: 2004 04 15	Scale: AS SHOWN	 Jacques Whitford Consulting Engineers Environmental Scientists
	Job No.: 14677	Fig. No.: 6.9.1	

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More recent migratory bird trends in New Brunswick are provided by the Canadian Bird Trends Web Site (Downes *et al.* 2003). This database provides population trends based on Breeding Bird Survey in Canada data collected from 1968 to the present (2002 data). Based on the trends for New Brunswick, most migratory bird groups have been declining, at least in recent years, with the exception of short-distance migrants and wetland species. Woodland species populations in New Brunswick increased from 1968 to 1970, remained stable from 1970 to 1990, and declined from 1990 to 2002.

Breeding populations of many forest birds are likely closely linked to the availability of suitable breeding habitat. An analysis of Landsat imagery from 1995 was used by Betts (1999) to determine the amount of clearcutting in the region from 1984 to 1995. Based on this analysis, it was determined clearcutting was occurring at a rate of 10.5% in the area of coverage (encompassing Ecodistrict 19) over the 11-year period, and resulted in a 4% loss of mature tolerant hardwood forest. This method did not account for small selective cutting that can also have an adverse environmental effect on mature forest habitat as suitable breeding habitat at least for some bird species. Using forest inventory data to compare land cover within the Project Assessment Area between the 1980's and 1996/2000, there has been a loss of 1,000 ha or 6.9% of mature forest through cutting or conversion to other uses over this time period. However, this does not account for the increase in mature forest from natural succession.

Most of the forested land in the Assessment Area is managed for timber production by private woodlot owners, industrial freehold landowners, and some Crown land lessees, especially in the south. The CVFPMB recommends an Annual Allowable Cut based on the productive capacity of the forest, so that the resource is managed sustainably. Industrial freehold and Crown licenses are more likely to be managed in this way, and to consider wildlife factors, including maintaining tracts of mature forest.

Agricultural land in the Carleton and Victoria Counties has increased substantially in the past decade; with a 15% increase in area of potato production from 1991 to 2001 (NB Potato Statistics Update, B. Ouellette, DAFA, pers. comm.), in part a result of conversion from forestland. However, using the same data set as above, only 74.5 ha (1.2%) of mature forest identified from 1984 aerial photography was converted to active agricultural land by 1996/2000.

Most residential development is small single dwellings, usually built relatively close to existing roads, or associated with agricultural land. Most commercial development is also on a relatively small scale, close to existing infrastructure. With the exception of a few major industries such as the McCain production facility on the opposite side of the Saint John River at Florenceville, no large scale industrial land use has been identified in the Assessment Area that would have contributed directly to mature forest habitat loss since 1984.

All of the identified past and present projects and activities have contributed to the fragmentation of habitats in the landscape. The landscape is already highly fragmented as has been documented



elsewhere (Betts 1999). There is very little unfragmented habitat left in the Assessment Area when considering all road types and anthropogenic development. One way to characterize whether an area can be considered unfragmented is based on a certain distance the area may be from roads. Using 1 km as a critical distance to consider the area of mature forest habitat under human influence (Canadian Council of Forest Ministers 1997), over 99% of the land in the vicinity of the Project is within 1 km of any road. This includes forestry roads, or anthropogenic open habitat (e.g., agricultural land), before Project construction. The land in the vicinity of the Grand Falls to Aroostook project has the same percentage. The Pokiok to Longs Creek area has 8% of the land base that is more than 1 km from roads. Most of this habitat is wetland and mature softwood forest on Crown land that will not be bisected by the new TCH.

6.9.4.2 Project Interactions with Other Future Projects and Activities

Habitat Loss

The assessment of habitat loss for the Project was based on the Project Assessment Area, and does not overlap the habitat surrounding most of the other current and future highway projects, excepting the Florenceville Bridge and Route 110 interchange project and the Route 95 (Woodstock to Houlton) highway twinning project. The Florenceville Bridge and Route 110 interchange project will have a very small amount of terrestrial habitat loss (<10 ha), including a few <1-ha patches of mature forest immediately adjacent existing provincial roads. The Route 95 project will likely involve the loss of some mature forest habitat, however this habitat will already border the existing highway. No planned development along the TCH, or other planned development will affect mature forest habitat.

Table 6.9.2 provides a summary of the amount of mature forest habitat estimated to be lost to the three highway projects. The Grand Falls to Aroostook and Pokiok to Longs Creek TCH projects will result in a loss of approximately 142 ha and 145 ha (respectively) of mature or overmature forest.

Table 6.9.2 Summary of Change in Mature Forest Habitat Area Due to TCH Projects

Statistic	Perth-Andover to Woodstock	Grand Falls to Aroostook	Pokiok to Longs Creek	Total
Total Area Assessed (ha)	78,894	23,524	26,285	128,703
Total Mature Habitat (ha)	13,537	3,823	8,572	25,932
Mature Habitat Lost (ha)	216	142	145	503
Mature Habitat Lost (%)	1.6%	3.7%	1.7%	1.9%

Taking the sum total of the mature forest habitat loss (503 ha), this represents the permanent loss of up to 1.9% of the mature habitat in the Assessment Area. This overall percentage is similar to that determined for the Project and therefore the arguments used during the assessment of environmental effects on Migratory Birds due to Construction (Section 5.7.5.2.1) should also be relevant. This habitat,



although to be permanently removed, represents a relatively small proportion of the forest land base, and will be removed over a number of years. Forestry within the spatial boundaries is managed differently depending on the landowner. The CVFPMB, representing private woodlot owners, supports an Annual Allowable Cut (AAC) of 4,000 ha per year, or 2% of the forested land base (185,000 ha) in the two counties. This AAC represents the productive capacity of the forest in private hands. This excludes industrial freehold land and Crown land, which is managed for sustainability and considers wildlife habitat in management plans. Although the CVFPMB has no formal management control over how much wood private woodlot owners cut in a year, the annual cut usually fluctuates +/- 5 or 10% around the AAC (i.e. from 3,600 to 4,400 ha are actually cut each year). When considering the TCH projects within Carleton and Victoria counties, the 358 ha of mature forest loss represents less than 10% of the AAC. As the RoW has undergone cutting for at least the past 1 1/2 years, and the remaining clearing will be spread out over the next two years, the cutting will be spread over several years, and would likely represent an average of 120 ha per year, which is within the year to year variability in the AAC (T. Fox, CVFPMB pers. comm.). Since 64% of the land base near Pokiok to Longs Creek is managed for timber production as Crown and industrial freehold lands (JWEL 2003a), there is a greater chance that the forests in this region are managed for sustainability, and consider wildlife issues such as mature forest. St. Anne-Nackawic which has a large proportion of the industrial freehold land in the area, and also has the Crown land license 8, has been able to modify its cutting plans to accommodate the planned cutting along the TCH RoW.

Habitat Fragmentation

The small future developments identified above are not likely to contribute substantively to this fragmentation. More widespread development such as forestry and agriculture will evidently contribute to fragmentation, but this is impossible to quantify, as large scale land use planning in the private land that makes up a high proportion of the landscape in the Assessment Area are not available. Therefore, an analysis of fragmentation is based on a comparison of the level of fragmentation before and after the construction of the three current and future TCH projects, based on available forest inventory mapping within the Assessment Area.

Betts (1999) looked at fragmentation of the landscape, focussing on the area of known distribution of AHF in the central St. John River Valley. To attempt to quantify fragmentation in the landscape, several of the metrics used by Betts (1999) were calculated for the habitat surrounding the three TCH projects for which forest inventory data was obtained (Perth-Andover to Woodstock, Grand Falls to Aroostook, and Pokiok to Longs Creek TCH projects). The boundaries chosen for the calculations were arbitrary and unbiased, using the available data coverage. The metrics from Betts (1999) and used in this analysis include perimeter/area ratio (metres/hectares), and patch size distribution. Other statistics provided include total number of patches (fragments), the change in the number of patches (percentage), and



average patch size. The habitat patches assessed were patches of forest classified as “mature” or “overmature”.

Table 6.9.3 compares the fragmentation metrics for land in the vicinity of all three current or future TCH projects before and after construction, as well as providing the summary statistics. Figures 6.9.2 to 6.9.5 provide the histograms showing the patch size distributions. These statistics and distributions are provided for comparing before and after the construction of the projects, and provide trends only, as there are many variables that are difficult to control (*i.e.*, the accuracy of the forest inventory data), and are dependent on the spatial boundaries of the data used.

The perimeter/area ratios and the shapes of the histograms are comparable to those in Betts (1999). The results support the conclusion that the area in the vicinity of each project is already highly fragmented. Most of the statistics in Table 6.9.3 do not suggest a large increase in fragmentation averaging over the landscape, however the histograms allows one to see how the distribution of patch size will apparently change. The shift in the patch size distribution is mostly an increase in patches 10 ha or less, mostly from the further fragmenting of small patches. The percentage of patches 20 ha or smaller increases by 1% from 83% to 84%. Some of these large patches are deceiving, however, with relatively high perimeter-to-area ratios, as many will have “holes” of younger or open habitats.

Table 6.9.3 Fragmentation Statistics on Mature/Overmature Habitat Patch Type in the Assessment Area

Statistic	Perth-Andover to Woodstock		Grand Falls to Aroostook		Pokiok to Longs Creek		Total	
	Before	After	Before	After	Before	After	Before	After
Total Mature Habitat (ha)	13,537.4	13,321.6	3,822.8	3,681.3	8,571.8	8,426.6	25,932.0	25,429.5
Change in Habitat (%)	NA	-1.6%	NA	-3.7%	NA	-1.7%	NA	-1.9%
Number of Patches	1,087	1,147	232	251	275	306	1,594	1,704
Change in Number of Patches (%)	NA	+5.5%	NA	+8.2%	NA	+11.3%	NA	+6.9%
Average Patch Size (ha)	12.5	11.6	16.5	14.7	31.2	27.5	16.3	14.9
Average perimeter (m)	2,279	2,158	2,806	2,596	4,174	3,745	2,683	2,508
Average* Ratio Perimeter/Area (m/ha)	292	309	261	272	314	349	292	311
NA = not applicable * based on average of ratios for each patch								



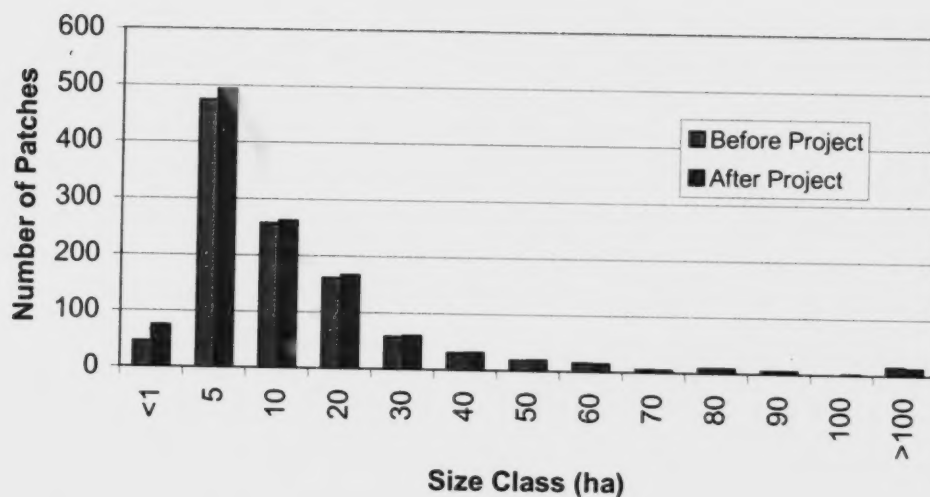


Figure 6.9.2 Mature Forest Patch Size Distribution - Perth-Andover to Woodstock.

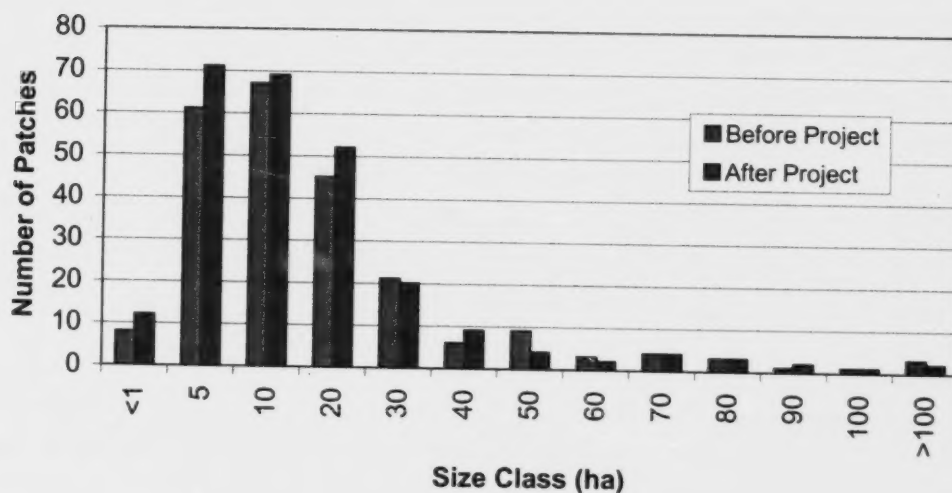


Figure 6.9.3 Mature Forest Patch Size Distribution - Grand Falls to Aroostook

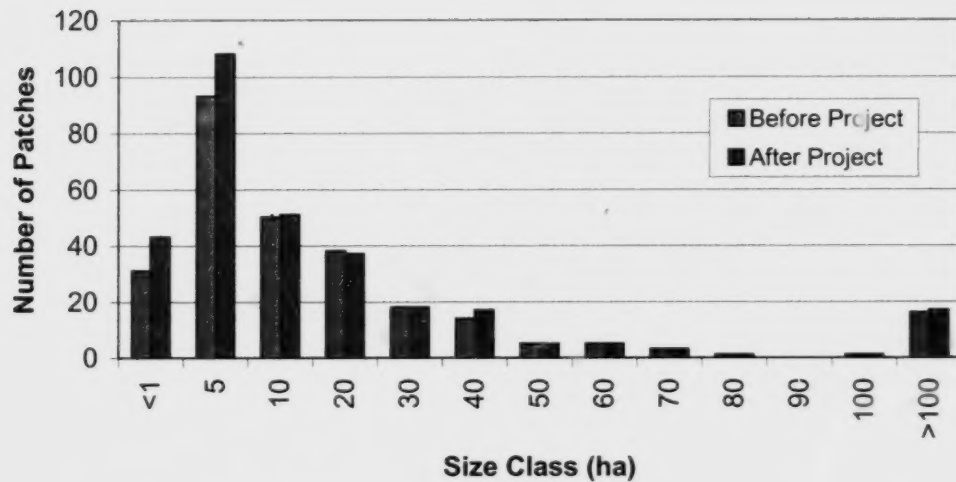


Figure 6.9.4 Mature Forest Patch Size Distribution - Pokiok to Longs Creek

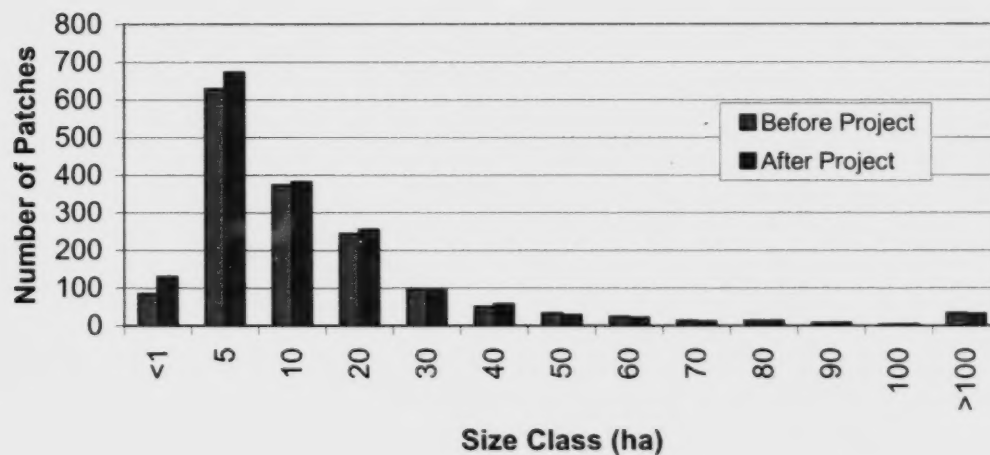


Figure 6.9.5 Mature Forest Patch Size Distribution - 3 TCH Projects Combined



These results demonstrate that it is difficult to evaluate habitat using this metric and GIS, although a powerful tool when evaluating landscape changes, are limited by the available data. Forest roads were not used to divide habitat into patches. Roadways and other linear features only subdivide habitats where a right-of-way is identified as a polygon within the forest inventory database. Nonetheless, it is possible to relate the change in patch size distribution to the potential environmental effects of fragmentation of mature forest migratory birds. The minimum habitat size for migratory birds considered mature forest-dependent vary by species, and also by study. Studies have noted that Wood Thrush are somewhat tolerant of forest fragmentation, as Wood Thrush may be found in habitat patches of 1 to 5 ha (Robbins *et al.* 1989, DeGraaf and Rappole 1995; cited by Banner and Schaller 2001). In a highly fragmented landscape in Ontario, Friesen *et al.* (1999, cited by Banner and Schaller 2001) did not find that Wood Thrush nesting success was related to distance from forest edge or forest size. However, others have found environmental effects that are attributable to edge and patch size in tracts 15 ha or less. Betts (1999) chose a minimum habitat size of 20 ha for Scarlet Tanager, which is approximately the minimum habitat size that would be chosen using the Cornell Lab of Ornithology's "A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other Forest-interior Birds" (Rosenberg *et al.* 1999) in a region where the landscape is 60% forested, and to have a high probability of encountering Scarlet Tanagers. Scarlet Tanagers are a good indicator for the detection of Wood Thrush, the focus of the cumulative environmental effects assessment, and other mature forest birds. During the field surveys conducted in support of the Project environmental assessment, Wood Thrush was recorded within 50% of the study sites where Scarlet Tanager was reported. Considering a 20 ha minimum habitat size, there are relatively few remaining large patches of mature forest in the landscape, however the TCH projects generally result in the further fragmentation of small patches, and in very few cases are larger tracts substantively reduced in size. Forest interior birds such as Wood Thrush and Scarlet Tanager are using the smaller fragments, according to the bird survey results, however breeding success was not investigated or confirmed. Also, these apparently small fragments may be adjacent to younger forests, essentially increasing the apparent size of the habitat patch, if the adjacent forest is old enough to not be considered edge habitat.

Fragmentation of habitats is inevitable when the habitat matrix is dominated by agricultural land in much of the landscape, which was avoided to the extent possible due to its high value in the region. As noted in other sections, had agricultural land not been avoided, the result would likely be the clearing and conversion of more forestland to agriculture.

During the breeding season, some species may be reluctant to cross clearings, causing populations to be isolated in resultant habitat fragments. Studies by the Canadian Wildlife Service (CWS) in Quebec of bird use of forest patches in agricultural areas found that bird movement between patches decreased with increasing distance between patches (Duchesne *et al.* 1999). The CWS study determined that 97.7% of the movements between habitat patches were concentrated in gaps smaller than 200 m and some species traveled up to three times as far to avoid a gap. Physical isolation of a population combined with the



deleterious environmental effects of edge may eliminate species in habitat fragments. To ensure that adjacent habitat patches will be used as a travel corridor by birds, the study suggested that the critical distance between two woodlands must not be greater than 200 m. The total width of the cleared RoWs for the TCH projects are near the 200 m threshold where the preferred 82.5 m between centrelines is used, depending on the terrain, and assuming there are no forested mediums planned or feasible. Wide medians are typically kept vegetated where possible for safety reasons (*i.e.*, as a barrier to oncoming headlights).

Within the areas surveyed in the Assessment Area, the most important area by far for Wood Thrush and Scarlet Tanager was bird survey site B2 south of Perth-Andover (Section 5.7.4.1 and Figure 5.7.1B), containing 50% and 40% (respectively) of the records of each species in the Project Assessment Area. Individuals were predominately recorded on the west part of the survey site, on the sloped areas. The tolerant hardwood forest up the slope and west of the mature mixedwood (the basis of the survey site delineation) is classified as immature in the forest inventory data, however is likely the preferred Wood Thrush habitat in this area. Mitigation for rare plant concentrations in this area included shifting of the alignment to the east, towards the existing TCH, minimizing the fragmentation of the mature habitat in this area. Further mitigation/compensation has included protecting the land from inevitable forest harvesting by arranging the purchase of a 48.8 ha section of this site, for conservation purposes.

Another concentration of Wood Thrush was recorded near bird survey site B6, where there was very little mature habitat. As was the case at Site B2, the Wood Thrush at this location were recorded west of the alignment at the time. However, due in part to the discovery of an S1/"May Be At Risk" plant species, among other rare plants just to the north, the alignment was shifted further east, increasing the distance between the Wood Thrush habitat and the Project. In addition, the habitat containing the rare plant concentrations and Wood Thrush are within a 23.6 ha parcel of land that has been purchased for conservation purposes, and protected from further forest harvesting. Most other records of Wood Thrush in the remaining survey locations (including those for Grand Falls to Aroostook and Pokiok to Longs Creek) were single individuals, or individuals recorded well outside of project boundaries. In fact, only a single Wood Thrush was recorded during surveys for each of the other two TCH projects.

6.9.4.3 Summary

Breeding populations of many forest birds are likely closely linked to the availability of suitable breeding habitat. Forest harvesting is likely the key activity that introduces change to the mosaic of different forest patches and ages, however other more permanent changes resulting in the conversion from forest to other land uses such as agriculture and roadbuilding. Within the Assessment Area, there has been a loss of 1,000 ha or 6.9% of mature or overmature forest, not accounting for the increase in mature forest from succession. Within this same area, only 74.5 ha (1.2%) of forest land has been converted to agricultural land. Residential, commercial, and industrial development account for a



relatively small amount of mature habitat conversion. Within the Assessment Area, the three current and future TCH projects will collectively result in the loss of 503 ha or 1.9% of the available mature habitat, over a period of several years. In the short term, this harvesting of mature forest will not likely increase the loss of mature forest in the landscape at a much higher rate than is currently occurring due to forest harvesting. The remaining planned projects will affect a negligible amount of mature forest.

A comparison of the current level of fragmentation of mature/overmature forest with the resultant fragmentation following the three current and future TCH projects was completed using the available forest inventory databases. The region is already highly fragmented. Very little of the landbase is located more than 1 km from a road, which can be used to define an unfragmented landscape, with respect to human disturbance. The patch size distributions were comparable to the analyses by Betts (1999). Average patch sizes are small to begin with, and reduced only slightly by the TCH projects.

Overall, there will be an increase in the number of habitat patches by 6.9%, mostly from the division of small patches into smaller patches. There was relatively little change in the number of large patches of mature forest, with no net change in habitat patches greater than 40 ha in size. With respect to mature forest migratory birds this information is related to minimum patch sizes, which can vary by species. Scarlet Tanager has recently been selected as an indicator species for investigations of fragmentation and the management of forest-interior birds (Betts 1999; Rosenberg *et al.* 1999), and Wood Thrush is to varying degrees found in similar habitat, depending on the region. Based on a minimum patch size of 20 ha, suitable patches are remaining relatively stable, with most of the fragmentation occurring in smaller, apparently unsuitable patch sizes. However according to bird survey results, smaller fragments are being used by forest interior birds such as Wood Thrush and Scarlet Tanager. Breeding success was not investigated. Based on this analysis, the region is already highly fragmented, but the further fragmentation as a result of the projects is not likely to substantially affect the number of larger fragments best suited for forest-interior birds.

The TCH projects will increase the distance between forest patches, and could form a barrier to the movement of forest birds, however the average width of the cleared RoW is likely below the threshold, beyond which birds are less likely to cross. Mitigation to reduce the overall width of the gap includes the use of forested medians, especially where these medians are quite wide.

Examination of the available location information for Wood Thrush collected for the Project demonstrates that the risk of loss and fragmentation of critical habitat for Wood Thrush has been minimized through Project mitigation. This included moving the alignment and protecting the avoided habitat by purchasing and protecting the habitat from future harvesting at the two largest concentrations of Wood Thrush. The protection of these habitats from other future land uses (*i.e.*, forest harvesting or conversion to agriculture) would at least partially compensate for the loss of potential Wood Thrush habitat by the Project.



6.9.5 Determination of Significance

The residual environmental effects of the Project include the loss of mature forest habitat, considered important habitat for selected migratory birds requiring mature forest as breeding habitat, and fragmentation of mature habitat. Analyses of fragmentation of mature forest (minimum patch size) and use of important habitat by Wood Thrush with respect to mitigation (habitat avoidance and minimizing fragmentation) and compensation (protection from other land uses) demonstrate that the Project will not contribute to cumulative environmental effects on Wood Thrush. Therefore, the cumulative environmental effects of the Project, in combination with other past, present, and future projects, is rated not significant.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.7 (Wildlife VEC), for the verification of the accuracy of the cumulative environmental effects analysis on migratory birds.

It is acknowledged that the Project will contribute to cumulative environmental effects on migratory birds due to habitat fragmentation and habitat loss in the Upper Saint John River Valley. Although the Project will not result in significant environmental effects, including cumulative environmental effects on migratory birds, it remains that these issues are important. Recognizing this, NBDOT will participate in an initiative to study the environmental effects of linear development on habitat fragmentation and habitat loss. It is understood that Environment Canada would lead such a study, in cooperation with other federal and provincial agencies, and that NBDOT will work cooperatively with them to consider the results in the planning of future highway projects in New Brunswick. NBDOT also recognizes that such a study may identify potential improvements to its current mitigation strategy that could be applied to the Project and other recent or planned TCH Projects in the Upper Saint John River Valley. Following the principles of adaptive management, NBDOT is willing to consider suggested improvements to mitigation that may come out of the study, provided it is technically and economically feasible, and reasonable to do so.

6.10 Cumulative Environmental Effects Analysis of Agricultural Land

6.10.1 Summary of Residual Environmental Effects of Project

The primary environmental effect of the Project on agricultural land is the direct loss of 223 ha of agricultural land within the RoW. This loss occurs during the construction phase (site preparation) and remains in perpetuity. Landowner compensation is accomplished primarily through land acquisition. However, despite economic compensation, the removal of agricultural land from production remains. In addition to land lost within the RoW, the development of the Project RoW may create remnant agricultural parcels (*i.e.*, severed properties without road access). However, NBDOT has agreed to



compensate through provision of financial compensation (land acquisition) or provision of alternate access. In those cases where financial compensation is awarded, the severed parcel of agricultural land may still be taken out of production, or it may be purchased by an adjacent landowner and kept in production. Therefore, the loss of agricultural land is considered to be a residual environmental effect of the Project. Due to compensation, the residual environmental effects of land loss and severances are considered not significant.

There is also the potential of cold air pooling as a residual environmental effect of the Project. Cold air pooling is a weather condition where a cold air mass, being heavier than the surrounding air, flows along the ground in a down gradient direction and experiences a resistance to flow and forms a shallow pool. The topography, land use and projected cut and fill locations (Figures 3.5A-D; Appendix C) of the planned RoW were examined to assess the potential for cold air pooling. The locations of the planned cuts are in areas where there are large differences in the terrain elevations such that the roadbed would present a relatively small barrier to drainage flows of cold air. Thus in these instances, the existing drainage flows would not be substantially affected. There are three areas along the RoW where the terrain and fill locations coincide to cause a potential for cold air pooling. The land use at these locations is expected to be potato farming with rotation crops such as grain, oil seed and hay. Since these are considered frost resistant, no substantial crop damage is expected to occur from cold air pooling, and cold air pooling is not identified as an issue for consideration in the cumulative environmental effects assessment for agriculture.

Damage to crops may occur where salt spray from winter safety applications is in close proximity to salt sensitive vegetation. In instances where it is demonstrated that salt damage has caused crops to fail, fair and reasonable compensation for damaged crops will be negotiated. Therefore, damage to crops from salt spray is not identified as an issue for consideration in the cumulative environmental effects assessment.

6.10.2 Identification of Issues and Selection of Indicators

The Project RoW, in combination with the RoW's of concurrent TCH projects, extends across Carleton and Victoria counties. This region plays an important role in provincial agricultural production (particularly potatoes and beef), as identified through concerns raised during provincial and public consultation. Therefore, the loss of agricultural land is identified as an issue for consideration in the assessment of cumulative environmental effects.

Agricultural land area has been selected as the indicator to focus the assessment of the potential cumulative environmental effects of the Project on loss of agricultural land in the region.



Table 6.10.1 identifies the potential interactions between the indicator and the other projects and activities identified in Section 6.3.

Table 6.10.1 Cumulative Environmental Effects Potential Interactions Matrix for Agriculture VEC

Past, Present or Future Project or Activity	AGRICULTURAL LAND VEC INDICATOR
	Agricultural Land Area
Existing Highways and Roads	
Existing TCH	✓
Local Highways and Roads	✓
Saint-Léonard to Grand Falls TCH	✓
Perth-Andover By-Pass TCH	✓
Woodstock to Pokiok TCH	✓
Current and Future Highway Projects	
Grand Falls to Aroostook TCH	✓
Florenceville Bridge and Route 110 Interchange	✓
Lockhart Mill Interchange TCH	✓
Meduxnekeag River Bridge TCH	
Route 95 (Woodstock to Houlton)	✓
Pokiok to Longs Creek TCH	✓
Adjacent Land Uses	
Forest Resource Harvesting	✓
Agriculture	✓
Hydroelectric Power Generation	
Pits and Quarries	✓
Residential	✓
Commercial	✓
Industrial	
Hunting	
Fishing	
Planned Development Along Proposed TCH	
Tobique Truck Stop (Perth-Andover)	✓
Grand Falls Big Stop	✓
Other Planned Development	
New Brunswick Potato Museum/Learning Center on Route 110	✓
Wakefield Salmon Hatchery	✓
Woodstock Wastewater Treatment Plant	



6.10.3 Assessment Boundaries

The spatial information used for the detailed assessment of Project-related cumulative environmental effects on agricultural land was derived from the NBDNR forest cover map tiles that were analyzed for the environmental assessment of vegetation for the Project, the Grand Falls to Aroostook TCH, and the Pokiok to Longs Creek TCH. Figure 6.10.1 depicts the combined area of these map tiles that comprise the Assessment Area for the potential cumulative environmental effects of the Project on agricultural land.

The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other past and present projects and activities on agricultural land is 1993, the time from which initial collection of agricultural land-use data was obtained by NBDNR, until the present. It is argued that with respect to agricultural land area, the conditions represented in the NBDNR maps are to some considerable extent, representative of past and present agricultural land development, and reflect a temporal boundary that although indeterminate, may extend for many years prior to the year of the surveys, listed above. Therefore, the cumulative environmental effects assessment does relate these data to antecedent land use and projects. Although current spatial data were not available for comparison with the NBDNR maps, description of regional trends was possible based on extensive public and stakeholder consultation, and the observations and professional opinions of the study team.

The temporal boundaries for the assessment of the potential cumulative environmental effects of the Project with other future projects and activities on agricultural land includes the next 5 years, beyond which the forecasting of the likeliness of other projects or activities to be carried out is not reliable.

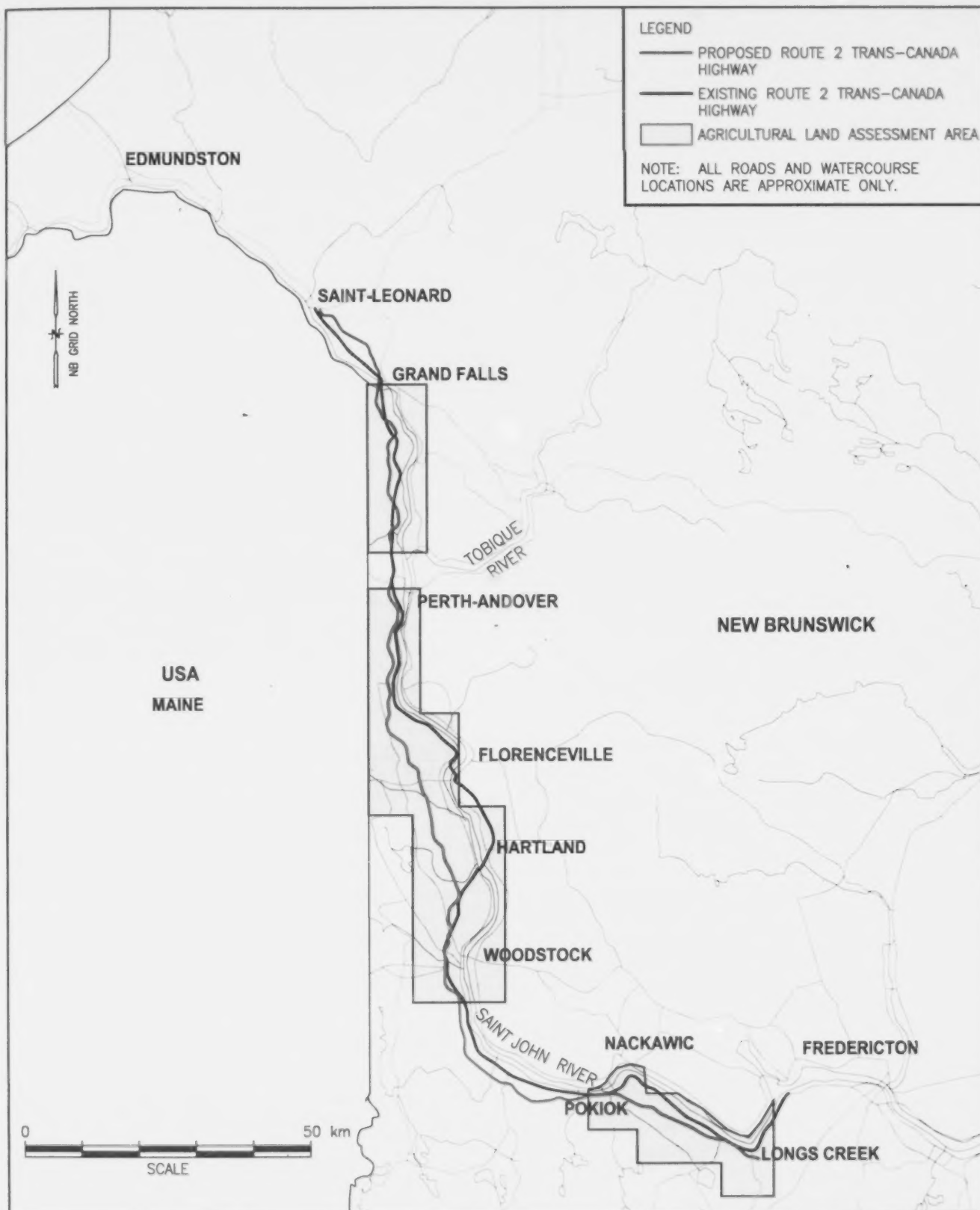
6.10.4 Agricultural Land Area

6.10.4.1 Historic Trends and Existing Conditions

Section 6.6.4.1 (Appalachian Hardwood Forest VEC) provides an overview of human settlement patterns and activities during the 19th and 20th century. These activities greatly influenced the conditions that were present at the time the maps were generated. Presently, agriculture dominates the landscape through most of the Assessment Area. Over the last fifty years, agriculture in Carleton and Victoria counties has grown to become the most important agriculture production area in the Province (George Maicher, pers. comm. 2003). Agricultural production in Carleton and Victoria counties has been predominantly located on the west side of the Saint John River, and is potato or potato-related through crop rotation. Between 1991 and 2001 there was a 15% increase in potato production area in these counties (NB Potato Statistics Update, Benoît Ouellette, DAFA, documentation) resulting in part from the conversion of forestland to agriculture.







SPATIAL BOUNDARIES FOR THE CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT OF AGRICULTURAL LAND

Date: 2004 04 20

Job No.: 14677

Scale: AS SHOWN

Fig. No.: 6.10.1



Jacques Whitford

Consulting Engineers
Environmental Scientists

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As determined from the Canada Land Inventory (CLI), 97% of soils in the Assessment Area between Perth-Andover and Woodstock are class 4 or better. The total area of agricultural land in the Assessment Area between Perth-Andover and Woodstock is 29,191 ha, or 37% of the environmental effects Assessment Area (Section 5.8).

6.10.4.2 Project Interactions with Other Future Projects and Activities

6.10.4.2.1 Existing Highways and Roads

This category includes the existing TCH, as developed in the 1960's, local highways and roads, and collector, secondary roads, and recently completed TCH projects. The existing TCH and other existing roads have permanently removed land for agricultural use. Specific spatial data is not available for this category. However, the agricultural land area as determined from the NBDNR maps reflects the loss of agricultural land area from these projects. No future interaction is anticipated.

6.10.4.2.2 Current and Future Highway Projects

The total amount of agricultural land area that will be removed from production within the RoW's of the Project in combination with the Grand Falls to Aroostook TCH Project and the Pokiok to Longs Creek TCH Project is 263 ha. This amounts to a 0.73% loss of agricultural land area within the Assessment Area, as seen in Table 6.10.2. The Rout 95 Project is outside of the Assessment Area, and the potential loss of agricultural land is not known as the RoW has not been selected at this time.

Table 6.10.2 TCH Project-related Agricultural Land Loss within the Assessment Area

	Perth-Andover to Woodstock TCH Project	Grand Falls to Aroostook TCH Project	Pokiok to Longs Creek TCH Project	Combined Projects
Assessment Area*	78,894 ha	23,524 ha	26,285 ha	128,703 ha
Agricultural Land within Project Specific Assessment Area	29,191 ha	6,587 ha	63 ha	35,841 ha
% Agricultural Land in Project Specific Assessment Area	37 %	28 %	0.24 %	28 %
Project Footprint**	1,053 ha	331 ha	468 ha	1,852 ha
Agricultural Land in RoW**	223 ha	36 ha	4 ha	263 ha
% Agricultural Land in RoW**	21 %	11 %	0.9 %	14 %
% of Agricultural Land within Project RoW** of the Total Agricultural Land within the Total Assessment Area	0.62 %	0.1 %	0.01 %	0.73 %
* as seen in Figure 6.10.1. is based on map tiles used in environmental effects analysis				
** RoW includes area for access road development				

According to the Canada Land Inventory (CLI), 97% of soils in the Assessment Area between Perth-Andover and Woodstock, and 90% of the soils in the Assessment Area between Grand Falls and



Aroostook are class 4 or better. As such, both stretches of highway have a very high potential for productive agricultural land. Therefore, it is likely that non-agricultural land (e.g., forest) will continue to be converted to agricultural land within this portion of the Assessment Area. It is unlikely that substantial agricultural development will occur within the Pokiok to Longs Creek portion of the Assessment Area.

6.10.4.2.3 Adjacent Land Uses

Other land uses within the Assessment Area (e.g., commercial, residential, pits and quarries) may remove some agricultural land area from production, or may use land that could have been converted to agricultural land. It is not possible to forecast what this demand for other land uses will be in the next 5 years. However, there are no indications that residential or commercial land use will increase substantially during that time. There may be some Project-related development of pits and quarries for aggregate required for construction of the proposed highway.

6.10.4.2.4 Planned Development Along Proposed TCH

The Tobique Truck Stop development will result in the loss of 3.6 ha of agricultural land formerly used for potato production. The Grand Falls Irving Big Stop will result in the loss of 5.4 ha of agricultural land also used for potato production. The combined loss of agricultural land area from these projects is 9 ha.

6.10.4.2.5 Other Planned Development

The New Brunswick Potato Museum and Learning Center will result in the loss of 0.8 ha of cleared field that could have been used for agricultural production. The Wakefield Salmon Hatchery will result in the loss of 0.8 ha of agricultural land. The combined loss of agricultural land area from these projects is 1.6 ha.

6.10.4.3 Summary

The Project, in combination with other TCH Projects, will result in a total loss of 263 ha (0.73%) of current agricultural land area within the Assessment Area. In addition, 1,589 ha of non-agricultural land will not be available for agriculture as it will be within the RoW. Some additional agricultural land area, albeit small, may be taken out of production due to inaccessible severances.

Planned development along the proposed TCH will result in an additional 9 ha of lost agricultural land area and other planned development will result in an additional 1.6 ha of lost agricultural land area. This



provides a total estimated loss of agricultural land area within the Assessment Area of 273.6 ha, or 0.76% of the total developed agricultural land area within the Assessment Area.

6.10.5 Determination of Significance

The conversion of land to agricultural land area within the Grand Falls to Aroostook and Perth-Andover to Woodstock portions of the Assessment Area was high during the period of 1991 to 2001. Current trends in agricultural practices (*i.e.*, converting forest land to agricultural land) suggest that this will continue or increase in the near future. The selection of the RoW for the Project, and for the Grand Falls to Aroostook Project, minimized the loss of developed agricultural land area. It is not anticipated that the loss of 273.6 ha of agricultural land area within the Assessment Area will compromise the ability of the agriculture industry to meet current market demands. Also, landowners will be compensated for any loss of land through land acquisition, or for severances through provision of alternate access roads. It is therefore concluded that the loss of agricultural land by the development of the Project, in combination with other past, present, and future projects and activities that will be carried out, will not result in a significant cumulative environmental effect. However, it should be noted that this may result in the conversion of an equal amount (273.6 ha) of non-agricultural land to agricultural land to maintain similar production levels in the region, or other measures such as increased use of fertilizer or other productivity-related measures. This future development may take place inside or outside of the Assessment Area.

There is no follow-up monitoring suggested, in addition to that already proposed in Section 5.13.3.8 (Land Use VEC), for the verification of the accuracy of the cumulative environmental effects analysis on agricultural land.





7.0 CONCLUSIONS AND RECOMMENDATIONS

In accordance with the requirements of Sections 16 (1) and (2) of *CEAA* and the Guidelines (Appendix A), this environmental assessment includes:

- A discussion of the alternatives to the Project and the alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means;
- A description of the proposed Project including the purpose and need, the proposed facilities and activities, and the potential malfunctions or accidental events that may occur in connection with the Project;
- A summary of consultation mechanisms and issues raised during consultation (*i.e.*, issues scoping) as well as a description of the methodological approach to the environmental assessment;
- An assessment of the environmental effects of the proposed Project for each of the VECs and the significance of the effects;
- An assessment of the effects of the environment on the Project;
- Recommendations for measures to mitigate any significant adverse environmental effects; and
- Recommendations for a follow-up program.

Based on the results of the environmental assessment, it is concluded that the Project is not likely to cause significant adverse environmental effects.

Approved by: Transport Canada

Approved by: Fisheries and Oceans Canada

Approved by: Infrastructure Canada





8.0 REFERENCES

8.1 Literature Cited

- ACCDC. 2003. Provincial Lists and Ranks. Internet Publication:
<http://www.accdc.com/products/lists/>. Last updated: 24/02/2003.
- ACCDC (Atlantic Canada Conservation Data Centre). 2002. Species Profile: Canada Clearweed (*Pilea pumila*). Internet Publication: <http://www.accdc.com/products/profiles/clearweed.html>. Downloaded December 2002.
- ACER. 2003. Environmental Background Study for the Proposed Upgrading of the Trans-Canada Highway, River de Chute to Florenceville, NB. Prepared for New Brunswick Department of Transportation.
- ACER (ACER Environmental Services Ltd.). 2002. Environmental Screening, Proposed Route 2 Upgrading and Lockhart Mill Road Interchange. Report to NBDOT. September 9, 2002.
- Acres. 1977. Regional Flood Frequency Analysis. Canada-New Brunswick Flood Damage Reduction Program.
- ADI Limited. 2003. Identification of a Realistic Provincial Standard Noise Threshold Level report prepared by ADI Limited for the New Brunswick Department of Transportation, Report: (55) 0600-454.1, April, 2003.
- Agfor Inc. 2003. Assessment of Market Stumpage Values on Private Land. Prepared for the New Brunswick Department of Natural Resources and Energy.
- Almkvist, E. (1999) 'Detailed climatic measurements above and beside the road', paper issued from Physical Geography, Department of Earth Sciences, Goteborg, Sweden, 10 pp.
- Anderson, P.G., B.R. Taylor and G.C. Balch. 1996. Quantifying the effects of sediment release on fish and their habitats. Canadian Manuscript Report on Fisheries and Aquatic Sciences, No. 2346.
- Banner, A., and S. Schaller. 2001. Gulf of Maine Watershed Habitat Analysis. USFWS Gulf of Maine Coastal Program. Internet Publication:
http://r5gomp.fws.gov/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm. March 2001.



- Barnes, J.L., M. Stephenson, L.H. Davey. 2000. An Integrated Approach to Cumulative Environmental Effects Assessment, Meeting the Requirements of the *Canadian Environmental Assessment Act*, in Proceedings of the 27th Annual Aquatic Toxicity Workshop: October 1-4, 2000, St. John's, Newfoundland. Edited by K.C. Penney, K.A. Coady, M.H. Murdoch, W.R. Parker and A.J. Niimi. Canadian Technical Report of Fisheries and Aquatic Sciences 2331, Fisheries and Oceans Canada, p. 20-33.
- Betts, M. 1999. Landscape Ecology Mapping Project: A Landscape Approach to Conserving the Appalachian Hardwood Forest. Nature Trust of New Brunswick, Fredericton, N.B.
- Betts, M. 2000. A Conservation Network for the Appalachian Hardwood Forest of the Saint John River Valley. Nature Trust of New Brunswick. Downloaded January 12, 2004 from <http://www.elements.nb.ca/theme/millennium/matt/betts.htm>.
- Blomqvist, G. 2001. De-icing salt ad the roadside environment: Air-borne exposure, damage to Norway spruce and system monitoring. Ph.D. Thesis, Department of Civil and Environmental Engineering, Royal Institute of Technology, Stockholm, Sweden. Internet Publication: <http://media.lib.kth.se:8080/dissengrefhit.asp?dissnr=3140>. Downloaded 09/09/2003.
- Bond, W.K., K.W. Cox, T. Heberlein, E.W., Manning, D.R. Witty, and D.A. Young. 1992. Wetland Evaluation Guide. Sustaining Wetlands Issue Paper, No. 1992-1. North American Wetlands Conservation Council (Canada), Ottawa, Ontario.
- Bruun-Schmidt, J. 1994. [Traffic killed animals in relation to landscape, topography and type of road]. Upubliceret specialerapport, Odense Universitet, Biologisk Institut.
- Canadian Council of Forest Ministers. 1997. Criteria and Indicators of Sustainable Forest Management in Canada. Technical Report. Cat. Fo75-3/6-1997E. ISBN 0-662-25623-9.
- CCME. 2000. Canada Wide Standards for Particulate Matter (PM) and Ozone, endorsed by the Council of Ministers of the Environment (CCME), June 5-6, 2000, Quebec City.
- CCME. 2002, 'Multi-Pollutant Emission Reduction Analysis Foundation (MERAf) for the Hot-Mix Asphalt Sector', prepared for Environment Canada and The Canadian Council of Ministers of Environment (CCME), prepared by Canadian Ortech Environmental Inc., and John Emery Geotechnical Engineering Limited, September 30, 2002.
- CCME (Canadian Council of Ministers of the Environment). 1998. Canada Wide Accord on Environmental Harmonization of the CCME and Canada Wide Environmental Standards Sub-Agreement (optional values).



- CCME. 1999. Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Updated 2001, 2002, 2003. Winnipeg. Publication No. 1299, ISBN 1-896997-34-1.
- CEAA (Canadian Environmental Assessment Agency). 1994. A Reference Guide for the *Canadian Environmental Assessment Act*, Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects. Prepared by the Federal Environmental Assessment Review Office.
- COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2004. Canadian Species at Risk, November 2003. Committee on the Status of Endangered Wildlife in Canada. 44 pp.
- Cowan, J.P. 1994. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York. 283pp.
- CRDC (Carleton Regional Development Commission Inc.). 2001. Carleton Area, New Brunswick, Canada Regional Profile.
- Crowell, M. Roadkill data collected for a 100 Series Highway, secondary highway and city streets in Nova Scotia over a two-year period (1993-1994). Unpublished data.
- Cumberland, R.E. and J.A. Dempsey. 1994. Recent confirmation of a cougar, *Felis concolor*, in New Brunswick. Canadian Field Naturalist 1008:224-226.
- CWS (Canadian Wildlife Service). 1987. Wetlands Atlas for New Brunswick. Environment Canada, Canadian Wildlife Service, Sackville, N.B.
- Department of Forestry and Rural Development. 1967. Land Capability Classification for Forestry, The Canada Land Inventory Report #4.
- Department of Forestry and Rural Development. 1969. Soil Capability Classification for Agriculture, The Canada Land Inventory Report #2.
- DFO. 2002. Atlantic Salmon Maritime Provinces Overview for 2001. DFO Stock Status Report D3-14 (2002).
- DFO (Fisheries and Oceans Canada). 1986. Policy for the Management of Fish Habitat. Ottawa, Ontario.
- DFO. 1995a. Factsheet #2. Blasting – Fish and Fish Habitat Protection. Department of Fisheries and Oceans. St. John's, Newfoundland.
- DFO. 1995b. Freshwater Intake End-of-Pipe Fish Screen Guideline. Ottawa, Ontario.
- DFO. 1999a. Guidelines for the Protection of Fish and Fish Habitat – Placement and Design of Large Culverts. Fisheries and Oceans Canada, Maritimes Region.



- DFO. 1999b. Status of Wild Striped Bass and Interaction Between wild and Cultured Striped Bass in the Maritime Provinces. DFO Science Stock Status Report D3-22.
- DFO. 2001. Atlantic Salmon Maritime Provinces Overview for 2000. DFO Stock Status Report D3-14 (2001) (revised).
- Dignam and Associates Consulting. 2003. Final Report: Heritage Evaluation for the Proposed Upgrade of Route 2 Between Route 560 at River de Chute and Route 10 at Florenceville. Report on file at Archaeological Services Unit, Province of New Brunswick.
- Dillon (Dillon Consulting Limited). 2003. Environmental Studies Route 2 – Florenceville to Woodstock. Prepared for New Brunswick Department of Transportation.
- Downes, C.M., B.T. Collins and M. Damus. 2003. Canadian Bird Trends Web site Version 2.1. Migratory Birds Conservation Division, Canadian Wildlife Service, Hull, Quebec. Internet Database: http://www.cws-scf.ec.gc.ca/birds/trends/default_e.cfm
- Duchesne, S., Bélanger L., Grenier M. and F. Hone. 1999. Guide to conserving forest corridors in an agricultural environment. Environment Canada, Canadian Wildlife Service (Québec Region) and Fondation Les oiseleurs du Québec Inc. http://www.qc.ec.gc.ca/faune/corridors_verts/corridors.html
- Dupuis, T.V., Bertram, P., Meyer, J., Smith, M., Kobriger, N., and Kaster, J. 1985. Effects of highway runoff on receiving waters, Volume III: Resource document for environmental assessments: Federal Highway Administration Final Report FHWA/RD-84/064, 153 p."
- Environment Canada. 1984. 'The Climate for Agriculture in Atlantic Canada', Atmospheric Service, Bedford, Nova Scotia.
- Environment Canada. 1970. The Canada Land Inventory Land Capability Classification for Wildlife. The Canadian Land Inventory Report No. 7. Environment Canada, Lands Directorate, Ottawa, Ontario.
- Environment Canada. 1991. The Federal Policy on Wetland Conservation. Environment Canada. Ottawa, Ontario.
- Environment Canada. 1993. Canadian Climate Normals 1961-90, vol. 6, Atlantic Provinces, A Publication of the Canadian Climate Program, Minister of Supply and Services Canada, 105 pp.
- Environment Canada. 1996. The Federal Policy on Wetland Conservation. Implementation Guide for Federal Land Managers. Environment Canada, Canadian Wildlife Service, Wildlife Conservation Branch. Ottawa, Ontario.
- Environment Canada. 1998. National Air Pollution Surveillance (NAPS) Network Annual Summary for 1995. Environmental Protection Series Report EPS 7/AP/28.



- Environment Canada. 1999a. National Air Pollution Surveillance (NAPS) Network Annual Summary for 1997. Environmental Protection Series Report EPS 7/AP/30.
- Environment Canada. 1999b. National Air Pollution Surveillance (NAPS) Network Annual Summary for 1996. Environmental Protection Series Report EPS 7/AP/29.
- Environment Canada. 2000. National Air Pollution Surveillance (NAPS) Network Annual Summary for 1998. Environmental Protection Series Report EPS 7/AP/31.
- Environment Canada. 2001a. National Air Pollution Surveillance (NAPS) Network Annual Summary for 2000. Environmental Protection Series Report EPS 7/AP/33.
- Environment Canada. 2001b. National Air Pollution Surveillance (NAPS) Network Annual Summary for 1999. Environmental Protection Series Report EPS 7/AP/32.
- Environment Canada. 2001c. Priority Substances List Assessment Report: Road Salts. Environment Canada and Health Canada, Ottawa, ON.
- Environment Canada. 2002a. Canadian Climate Normals 1971–2000. Internet Publication: <http://www.climate.weatheroffice.ec.gc.ca>.
- Environment Canada. 2002b. National Air Pollution Surveillance (NAPS) Network Annual Summary for 2001. Environmental Protection Series Report EPS 7/AP/34.
- Environment Canada. 2003a. Guidelines for Migratory Bird Survey, Trans-Canada Highway, Route 2 Upgrade, Perth-Andover to Woodstock, NB. Letter to Debbie de Grasse, Transport Canada, January 20, 2003. EAS#1998-029E2.
- Environment Canada. 2003b. Lightning Activity in Major Cities in Canada – Lightning in Atlantic Canada. Internet Publication: <http://www.msc.ec.gc.ca/education/lightning/>.
- Environment Canada. Unpublished. Rainfall Intensity-Duration and Frequency Values for Fredericton and St. Leonard, New Brunswick. Atlantic Climate Centre, Fredericton, NB. Data provided January 15, 2004.
- Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr., K.J. Sernka and R.E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee, Washington, DC.
- Erritzoe, J., T.D. Mazgajski, and L. Rejt. 2003. Bird casualties on European roads – a review. *Acta Ornithologica* 38:77-93.



- Erskine, A.J. 1992. Atlas of Breeding Birds of the Maritime Provinces. Nimbus Publishing and the Nova Scotia Museum, Halifax, NS. 270 pp.
- Fuellhaas, U., C. Klemp, A. Kordes, H. Ottersber, M. Pirmann, A. Thiessen, C. Tshoetschel, and H. Zucchi. 1989. Untersuchungen zum Strassentod von Vögeln, Säugetieren, Amphibien und Reptilien. Beiträge Naturkunde Niedersachens 42:129-147.
- GCSI (Global Change Strategies International Inc.) and MSC (Meteorological Service of Canada). 2000. Water Sector: Vulnerability and Adaptation to Climate Change. Report by Global Change Strategies International Inc and The Meteorological Service of Canada. Technical background paper presented at Canadian Society of Civil Engineering conference held in Moncton, N.B. on May 11 to 12, 2000. Internet Publication: <http://www.gcsi.ca/downloads/ccafwater.pdf>
- Golet, F.C. 1973. Classification and Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast. Ph.D. thesis, University of Massachusetts.
- Gore, J. A. 1983. The distribution of desmognanthine larvae (Amphibia: Plethodontidae) in coal surface impacted streams of the Cumberland Plateau, USA. Journal of Freshwater Ecology 2:13-23.
- Greater Vancouver Regional District . 2001. 2000 Lower Fraser Valley Ambient Air Quality Report, Acceptable Objectives.
- Health Canada. 1996. Guidelines for Canadian Drinking Water Quality. 6th Edition.
- Health Canada. 2003. Summary of Guidelines for Canadian Drinking Water Quality. Internet Publication: <http://www.hc-sc.gc.ca/hecs-sesc/water/pdf/summary.pdf> .Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kinsgley, W. Ross, H. Spaling and D. Stalker. 1999. Cumulative Effects Assessment Practitioners Guide. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec.
- Heritage Technologies Inc. 2003. Final Report Archaeological Surveying and Subsurface Testing for the Proposed Woodstock to Florenceville Highway Project. Report on file at Archaeological Services Unit, Province of New Brunswick.
- Hinds, H.R. 2000. The Flora of New Brunswick. Second Edition. University of New Brunswick, Fredericton, New Brunswick.
- Hooper, W.C., L. McCabe and T. Robertson. 1995. A Standardized Fisheries Stream Survey for Atlantic Canada. Department of Natural Resources and Energy, Fish and Wildlife Branch, Fredericton, NB.



- Hooper, W.C. 1997. Strategy to Assess and Monitor Lake and Stream Ecosystem Health in New Brunswick. Presented at the Canadian Council on Ecological Areas Annual Meeting. September 15-17, 1997.
- ICF Consulting. 1999. Emission factors, global warming potentials, unit conversions, emissions, and related facts.
- Jutterblock, J.E. 1990. Variation in larval growth and metamorphosis in the salamander *Desmognanthus fuscus*. *Herpetologica* 46:291-303.
- JWEL (Jacques Whitford Environment Limited). 1997. Eel River Botanical Survey, Route 2 By-pass, Alignment A and J, Meductic, New Brunswick. Report to the New Brunswick Department of Transportation. Project #9169. November 25, 1997.
- JWEL. 1998. Northumberland Strait Crossing Project Terrestrial Environmental Effects Monitoring Program: 1997 Results. Prepared for Northumberland Strait Crossing Inc.
- JWEL. 2003a. Environmental Background Study Route 2 (TCH) Bypass Perth-Andover to Route 560 (River de Chute). Final Report to NBDOT - Planning and Land Management.
- JWEL. 2003b. Environmental Background Study - Route 2 Bypass, Pokiok/Nackawic Area to Longs Creek. Final Report to NBDOT - Planning and Land Management.
- JWEL. 2003c. Addendum to Environmental Background Study - Route 2 Bypass, Pokiok/Nackawic Area to Longs Creek. Letter Report to NBDOT - Planning and Land Management.
- JWEL. 2003d. Environmental Assessment Tobique Truck Stop Wolastokwik Negoot-gook (Maliseet Nation at Tobique) Perth-Andover, New Brunswick, Final Report.
- JWEL. 2003e. Environmental Screening Report - Route 2 Bypass, Pokiok/Nackawic Area to Longs Creek. Final Report to NBDOT - Planning and Land Management.
- JWEL. 2003f. Heritage Resource Impact Assessment Route 2 Four-Lane Highway Perth-Andover to River de Chute, NB, on file at Archaeological Services Unit, Province of New Brunswick.
- JWEL. 2004. New Route 2 Trans Canada Highway Project Grand Falls to Aroostook, New Brunswick.
- Kamstra, J. 1991. Rediscovery of the northern dusky salamander, *Desmognanthus f. fuscus* in Ontario. *Canadian Field Naturalist* 105: 561-563.
- Kobriger, N.P., Meinholz, T.L., Gupta, M.K., and Agnew, R.W. 1981. Constituents of highway runoff Volume III, Predictive procedure for determining pollution characteristics in highway runoff: Federal Highway Administration Final Report FHWA/RD-81/044, 205 p



- Leedy, D.L. and L. W. Adams. 1982. Wildlife Considerations in Planning and Managing Highway Corridors. Report No. FWHA-TS-82-212. Office of Research, Federal Highway Administration. US Department of Administration, Washington.
- Libby, C. 2000. Eastern Cougar. Internet Publication:
<http://www.elements.nb.ca/themw/endangeredspecies/cougar/eastern.htm> .
- MacDougall, A. 1997. Appalachian Hardwood Forest Conservation Stewardship Project: Phase I Summary Report. The Nature Trust of New Brunswick, Fredericton, N.B.
- MacDougall, A. and J. Loo. 1998. Natural History of the Saint John River Valley Hardwood Forest of Western New Brunswick and Northeastern Maine. NR Can. Information Report M-X-204E. Canadian Forest Service. Atlantic Forestry Centre.
- Maritimes & Northeast Pipeline Management Ltd. 2002. Mainline Expansion Application GH-3-2002 Proceeding; File 3400-M124-14, Environmental Screening Report, National Energy Board.
- May, D. N. 1978. Handbook of Noise Assessment. VanNostrand Reinhold Company, Toronto, ON.
- Mine Environment Neutral Drainage (MEND) Program. 1991. Acid Rock Prediction Manual.
- Munday, D.R., G.L. Ennis, D.G. Wright, D.C. Jeffries, E.R. McGreer and J.S. Mathers. 1986. Development and Evaluation of a Model to Predict Effects of Buried Underwater Blasting Charges on Fish Populations in Shallow Water Areas. Canadian Technical Report of Fisheries and Aquatic Sciences, No. 1418. Department of Fisheries and Oceans, Habitat Management Division, Vancouver, B.C.
- NatureServe. 2002. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.6. Arlington, Virginia, USA: NatureServe. <http://www.natureserve.org/explorer> .
- NB Power. 1991. Environmental Protection Plan. July 1991.
- NBDAFA (New Brunswick Department of Agriculture, Fisheries and Aquaculture). 2003. Agriculture Environment Management Initiative.
- NBDELG (New Brunswick Department of Environment and Local Government). 2003a. New Brunswick air quality monitoring results for the year 2001. Technical Report T-2002-02. Sciences and Reporting Branch, Fredericton, N.B.
- NBDELG. 2002a. Guidelines for the Siting and Operation of a Construction and Demolition Debris Disposal Site.
- NBDELG. 2002b. Watercourse Alterations Technical Guidelines. Regional Services Branch.



- NBDELG. 2003b. New Brunswick's Wellfield Protection Program. Internet Publication:
<http://www.gnb.ca/0009/0371/0001/0001-e.html>. Downloaded 21/08/2003
- NBDELG. 2003c. Guideline for the Management of Contaminated Sites. Version 2. November 2003.
Available online at: http://www.atlanticrbca.com/eng/nb_guideline_v2.html
- NBDNR (New Brunswick Department of Natural Resources). 2003a. General Status of Wildlife in
New Brunswick. <http://www.gnb.ca/0078/fw/wstatus/index-e.asp>
- NBDNR. 1979. Geological Map, New Brunswick. Compiled by R.R. Potter, J.B. Hamilton, and J.L.
Davies, Map Number NR-1, Second Edition.
- NBDNR. 2003b. New Brunswick Big Game Harvest Reports 2002. Fish and Wildlife Branch.
<http://www.gnb.ca/0078/fw/biggame-e.asp> . 35 pp.
- NBDNR. unpublished. Assessing the impact of the highway twinning project on Butternut (Comments
from NBDNR) and Information on Butternut (*Juglans cinerea*) in New Brunswick (NBDNR
unpublished data. Dec. 10, 2003.
- NBDNRE (New Brunswick Department of Natural Resources and Energy). 1989. Rapport
D'Inventaire (1986) Forestier du Nouveau-Brunswick. Report No. NRE/RNE-89-01-003.
- NBDNRE. 1995. Natural Resources and Energy 1994-95 Annual Report.
- NBDNRE. 2002a. The General Status of Wildlife in New Brunswick - Draft Report (Vascular Plants).
- NBDNRE. 2002b. Natural Resources and Energy 2001—2002 Annual Report.
<http://www.gnb.ca/0078/2001-02annualreport.pdf>
- NBDNRE and NBDELG. 2002. New Brunswick Wetlands Conservation Policy.
<http://www.gnb.ca/0078/reports/wetlands/wetlands.pdf>
- NBDOE (New Brunswick Department of Environment). 2000. New Brunswick air quality monitoring
results for the year 1999. Technical Report T-2000-08.
- NBDOE. 1980. Fredericton Planning Region Water Resources Review. Water Resources Branch,
Report I-8001.
- NBDOE. 1999a. New Brunswick air quality monitoring results for the year 1998. Technical Report T-
9904. Environmental Evaluation Section, Fredericton, N.B.



- NBDOE. 1999b. New Brunswick air quality monitoring results for the year 1996 and 1997. Technical Report T-9901. Environmental Evaluation Section, Fredericton, N.B.
- NBDOT. 1989. A Highway Improvement Plan for the Trans-Canada Highway Through New Brunswick *in Adequate Highways – A Key to Regional Economic Development*.
- NBDOT. 1992a. Bridge Maintenance Manual.
- NBDOT. 1992b. Highway Maintenance Management System Field Manual.
- NBDOT. 1993. The White Paper – Highways for the Next Century *in Adequate Highways – A Key to Regional Economic Development*.
- NBDOT. 1994. Province of New Brunswick National Highways Improvement Plan.
- NBDOT. 1998a. Environmental Protection Plan, Third Edition.
<http://www.gnb.ca/0113/envpp/dotEnvPp.PDF>
- NBDOT. 1998b. Summary of Environmental Review Proposed Upgrading Route 2 Bull's Creek to Meductic.
- NBDOT. 1998c. Summary of Environmental Review Proposed Upgrading Route 2 Meductic to Pokiok.
- NBDOT. 1999. Summary of Environmental Review for the CEAA, Transport Canada, Proposed Bypass Alignment, Route 2, Sainte-Leonard to/a Grand Falls/Grand Sault.
- NBDOT. 1999a. Summary of Environmental Review for the CEAA, Transport Canada, Proposed Bypass Alignment, Route 2, Saint-Léonard to/a Grand Falls/Grand Sault. March 1999.
- NBDOT. 1999b. Amendment to Summary of Environmental Review for the CEAA, Transport Canada, Proposed Bypass Alignment, Route 2, Saint-Léonard to/a Grand Falls/Grand Sault. March 1999.
- NBDOT. 2001. Amendment to Summary of Environmental Review for the CEAA, Transport Canada, Proposed Bypass Alignment, Route 2, Saint-Léonard to/a Grand Falls/Grand Sault. April 2001.
- NBDOT. 2002. CSIF Prospective Analysis Route 2- Grand Falls to Longs Creek. ADI Limited Report 55 0600-457.1.
- NBDOT. 2003. Standard Specifications. <http://ftp.dot.gnb.ca/specs/default.html>
- NBDOT 2004. Moose-Vehicle Collision Information. Internet address:
<http://www.gnb.ca/0113/moose/alert-e.asp>.



- New Brunswick Culture and Sport Secretariat, Heritage Branch. 2004. Guide to Heritage Resource Impact Assessment in New Brunswick. New Brunswick Manuscripts in Archaeology 35. Edited by Archaeological Services.
- New Brunswick Culture and Sport Secretariat, Heritage Branch. 2001. New Brunswick's Designated Provincial Historic Sites. <http://www.gov.nb.ca/scripts/culture/heritage/designhist-e.idc> . Last updated 05/2001. Downloaded 3/06/2001.
- New Brunswick Department of Tourism and Parks. 2001. River Valley Scenic Drive Consumer Profile.
- Noss, R. 2003. The Ecological Effects of Road Construction. Downloaded December 18, 2003 from <http://www.wildlandscpr.org/resourcelibrary/reports/ecoleffectsroads.html>
- Peabody, G. 1998. A Unique Hardwood Forest. Nature Trust of New Brunswick. Downloaded January 12, 2004 from <http://www.elements.nb.ca/theme/forest/ahf/ahf.htm>
- Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London 587 pp.
- Pommen, L.W. 1983. The Effect on Water Quality of Explosives Use in Surface Mining. Volume 1: Nitrogen Sources, Water Quality, and Prediction and Management of Impacts. Ministry of Environment Technical Report, Victoria, B.C.
- Reijnen, R. and R. Foppen. 1994. The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for Willow warblers breeding close to a highway. *Journal of Applied Ecology*. 31:85-94.
- Roland, A. E. 1998. Roland's Flora of Nova Scotia. Second Edition (revised by M. Zinck). Nova Scotia Museum/Nimbus. Halifax, N.S.
- Rosenberg, K.V., R.W. Rohrbaugh, Jr., S.E. Barker, J.D. Lowe, R.S. Hames, and A.A. Dhondt. 1999. A land managers guide to improving habitat for Scarlet Tanagers and other forest-interior birds. The Cornell Lab of Ornithology.
- Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada. Ottawa.
- Smiley, A. 2002. Moose Accident Countermeasures: New Brunswick Highway 7. Report by Human Factors North Inc. for NBDOT.



- TAC (Transportation Association of Canada). 1999. Geometric Design Guide for Canadian Roads. Transportation Association of Canada
- TAC. 1998. Manual of Uniform Traffic Control Devices, Fourth Edition.
- Takats, D.L., C.M. Francis, G.L. Holroyd, J.R. Duncan, K.M. Mazur, R.J. Cannings, W. Harris, and D. holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp. <http://www.bsc-eoc.org/download/Owl.pdf>
- TEDCO (Tobique Economic Development Corporation). 2003. Traditional Ecological Knowledge Study in Relation to the Twinning of the Highway Project from Pokiok to Longs Creek.
- Therrien, J, and G. Bourgeois. 2000. Fish Passage at Small Hydro Sites. Report by Genivar Consulting Group for CANMET Energy Technology Centre, Ottawa, 114 p.
- Trow Consulting Engineers Ltd. 1996. Instream Sediment Control Techniques Field Implementation Manual. Ontario Ministry of Natural Resources. Northeast Science & Technology. FG-007. 109p
- US EPA. 1996. Indicators of the Environmental Impacts of Transportation – Highway, Rail, Aviation, and Maritime Transport. Policy, Planning, and Evaluation, EPA 230-R-96-009.
- US EPA. 2000. AP-42: Compilation of Air Pollutant Emission Factors, Volume 2: Mobile Sources. Office of Mobile Sources, United States Environmental Protection Agency.
- US EPA. 2001. Air Quality Criteria for Particulate Matter, Volume I, USEPA, Second External Review Draft, March 2001, EPA 600/P-99/002aB.
- US EPA. 2002. Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition. United States Environmental Protection Agency.
- Washburn and Gillis Associates Ltd. 1997. Heritage Resources Evaluation Proposed Trans-Canada Highway Corridor Grand Falls to St. Leonard. Report on file at Archaeological Services Unit, Province of New Brunswick.
- Washburn and Gillis Associates Ltd. 1998. Environmental Field Guide. Prepared for the New Brunswick Department of Transportation.
- Westcoast Energy Inc. 2002. Revised Draft Comprehensive Study Report for the Grizzly Extension Pipeline and Weejay Lateral. Prepared by Jacques Whitford Environment Limited and AXYS Environmental Consulting Ltd.
- Wilder, I.W. 1913. The life history of *Desmognathus fusca*. Biological Bulletin 24:251-342.



Wright, D.G, and G.E. Hopky. 1998. Guidelines for the use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107, Department of Fisheries and Oceans, Ottawa, Ontario.

8.2 Personal Communications

Allen, Patricia. Culture and Sports Secretariat. Fredericton, New Brunswick. August 6, 2003.

Antworth, Kevin. Director Carleton County, N.B. Cattle Marketing Agency. 2003.

Antworth, Ross. New Brunswick Federation of Snowmobile Clubs. July 2003.

Arseneau, Emile. Fisheries Officer, DFO, St. Leonard. 2003

Bagnall, Bruce A., Botanist/Bryologist, B&B Botanical, Nauwigewauk, NB. January, 2004.

Banks, Susannah. Executive Director. N.B. Soil and Crop Improvement Association. Fredericton, New Brunswick. 2003.

Barner, Wendy. Dump Closures Section, Remediation Branch, New Brunswick Department of Environment and Local Government. Fredericton, New Brunswick. July 2003.

Bernard, Emery. Registry of Agricultural Land and Farm Land Identification Program, Land Development, DAFA. Fredericton, New Brunswick. 2003.

Blaney, Sean. Botanist, Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, November 2002.

Boucher, Serge. Junior Planner, the Kent District Planning Commission. Bouctouche, New Brunswick. 2003.

Bourque, Gilles. Culture and Sports Secretariat. Fredericton, New Brunswick. August 6, 2002.

Brennan, Joe. Director and President, Agricultural Producer's Association of New Brunswick. 2003.

Brennan, Peter. Land Development Officer, N.B. Department of Agriculture, Fisheries and Aquaculture. Wicklow, New Brunswick. 2003.

Brown, Betty. New Brunswick. Partners in Agriculture 2003.

Busby, Dan. Biologist, Canadian Wildlife Service. Sackville, New Brunswick, 2003.

Cameron, Cecil. Aboriginal Resource Consultants, March 1, 2004.



Crandlemeir, Ed. Dairy Producers Association. 2003.

Crowell, Mike. Botanist, Jacques Whitford Environment Limited, Dartmouth, Nova Scotia, September 16, 2003.

Culberson, Roy. President, Potato Shipper's Association. 2003.

Cunjak, Rick. Fellow, Canadian Rivers Institute. 2003

Currie, Ted. Habitat Assessment Biologist, DFO, Moncton. 2003

Curry, Allen. Fellow, Canadian Rivers Institute. 2003

Daigle, Jean-Louis. Executive Director, Eastern Canada Soil and Water Conservation Centre. Grand Falls, New Brunswick. 2003.

Demarsh, Peter. Director. New Brunswick Federation of Woodlot Owners. 2003.

Dickenson, Kim. Fishery Officer, DFO, Woodstock. 2002.

Duplessis, Brian. Professional Agrologists of New Brunswick. Fredericton, New Brunswick. 2003.

Fairchild, Gordon. Ph.D. Soil Specialist, Eastern Canada Soil and Water Conservation Centre. Grand Falls, New Brunswick. 2003.

Fava, Erica. Environmental Farm Planner Coordinator, APANB. Fredericton, New Brunswick. 2003.

Ferguson, Albert. Culture and Sports Secretariat – archaeological resources, Oct 2002; May 26, 2003.

Fox, Tim. Carleton Victoria Forest Products Marketing Board. 2003.

Green, Oulton. Local Resident. Summerfield, New Brunswick. September and October 2002.

Holyoke, Tim. ADI, Fredericton, New Brunswick. July 2002.

Jones, Ross. Salmonid Research, DFO, Moncton. 2003.

Kee, Robert. Manager, Accounts Receivable Section, Finance. Fredericton, New Brunswick. 2003.

Laforge, Jacques. Director for Victoria and Madawaska Counties, New Brunswick. Dairy Producers Association. Fredericton, New Brunswick. 2003.

Lamoreau, Sterling. Local Resident. Middle Sackville, New Brunswick. Oct 2002.

Landry, Mark. Gérant municipal, La Ville de Bouctouche Inc. Bouctouche, New Brunswick. 2003.



Lavender, Fulton L. Naturalist (Birds), Dartmouth, Nova Scotia. 2003.

Libby, Cade. Biologist, Big Game/Furbearer Section, Fish and Wildlife Branch, NBDNR, Fredericton, New Brunswick. 2003.

MacDonald, Patton. Executive Director, Potato NB. Centreville, New Brunswick. 2003.

MacDonald, Mike. Biologist, Jacques Whitford Environment Limited,

Maicher, George. Agronome Économiste Politiques et Planification, DAFA. Fredericton, New Brunswick. 2003.

Makepeace, Scott. Biologist, Forest Habitat Section, Fish and Wildlife Branch, NBDNR. Fredericton, New Brunswick. 2002.

Melanson, Gary. General Manager, Enterprise Carleton Region. Woodstock, New Brunswick.

Michaud, Benoit. La Ferme Michaud Farm Ltée. Bouctouche Bay, New Brunswick. 2003.

Mitchell, Simon J. Forest Certification Coordinator, Falls Brook Centre. New Brunswick. 2003.

Moore, Lynn M. P. ag. Manager, Resource Development Section, Land Development Branch, DAFA. Fredericton, New Brunswick. 2003.

Nicholls, Katrina. Executive Director, Agricultural Producers Association of New Brunswick. Fredericton, New Brunswick. 2003.

O'Brien, Wayne. Business Consultant, Enterprise Carleton Region. Woodstock, New Brunswick. 2003.

Ouellette, Benoit. Business Development. New Brunswick Potato Statistics Update. 2003.

Pickard, Gerard. Soil and Crop Association of New Brunswick. 2003.

Prentice, Norman. Manager, Regional Biology Unit (Region 4), NBDNR. Edmundston, New Brunswick. 2003.

Prosser, Doug. Project/Forestry Resource Consultant, AGFOR Inc. Fredericton New Brunswick. 2003

Russel, John. Environmental Analyst, Agricultural Products Association of New Brunswick. Fredericton, New Brunswick. 2003.

Seaman, Allan. Geologist, NBDNR. Fredericton, New Brunswick. June 18, 2003.

Seymour, Pamela. Biologist, NBDNR, Fredericton. 2003.



Simpson, Jamie. Nature Trust of New Brunswick, Fredericton, New Brunswick. 2003.

Smith, Jennifer. Local resident. Wicklow, New Brunswick. October 2002.

Swanson, Lee. Biologist, Wetlands and Coastal Habitat Section, NBDNR. Fredericton, New Brunswick. July 21, 2003.

Tepper, Hank. New Brunswick Soil and Crop Association. Drummond, New Brunswick. 2003.

Toner, Maureen. Biologist, Species at Risk Section, Fish and Wildlife Branch, NBDNR. Fredericton, New Brunswick. July 21, 2003, and email dated August 1, 2002.

Vienna Brown (local resident), Wilklow New Brunswick, Sept 2002.

Watson, Alfred. Maple Sugar and Christmas Trees. 2003.

Wilson, Reg. NBDNR. Fredericton, New Brunswick. April 23, 2003.





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Final Comprehensive Study Report Volume 2 of 2



APPENDIX A

**GUIDELINES FOR THE PREPARATION OF A COMPREHENSIVE STUDY REPORT
PERTH-ANDOVER TO WOODSTOCK TWINNING OF ROUTE 2
TRANS-CANADA HIGHWAY, NEW BRUNSWICK**





Guidelines for the preparation of a Comprehensive Study Report

Perth-Andover to Woodstock Twinning of Route 2 –Trans Canada Highway, New Brunswick

INTRODUCTION

Purpose

Transport Canada and Fisheries and Oceans Canada has prepared these "Guidelines for the Preparation of a Comprehensive Study Report for the Perth-Andover to Woodstock Twinning of Route 2 – Trans Canada Highway Project" ("Guidelines") pursuant to their authority as responsible authorities under the *Canadian Environmental Assessment Act*. This has been done, in consultation with other federal and provincial authorities. These Guidelines include the information requirements of the New Brunswick Department of Environment and Local Government with respect to the registration of the Project pursuant to the New Brunswick *Environmental Impact Assessment Regulation*. These Guidelines set the scope of the project, the scope of the environmental assessment, including the key factors and valued environmental components that must be considered in the environmental assessment.

The document is divided into two key parts: the content of the comprehensive study report and its presentation. In addition, the introduction describes the project, the responsible authorities, the application of the environmental assessment processes, the scope of the project, and the requirements for public participation.

Background

The Trans-Canada Highway (Route 2) through New Brunswick is 519 km in length from Nova Scotia to Quebec. Approximately 130 km or 25 % remains to be twinned.

On August 14, 2002, the federal and provincial governments committed to the twinning of the Trans Canada Highway, the Route 2, in New Brunswick. The proposed Highway Upgrade from Perth-Andover to Woodstock will be approximately 70 kilometres in length and will be funded under the Canadian Strategic Infrastructure Fund (CSIF) program. The federal government will share 50% of the estimated cost of \$400 million. The CSIF was announced in Budget 2001. The Canadian Strategic Infrastructure Fund Agreement between Infrastructure Canada, Transport Canada and the Province of New Brunswick was signed on April 30, 2003.

The proposed undertaking will commence just south of the Trans-Canada Highway/Route 190 Interchange in the Village of Perth-Andover, will continue past River

de Chute, Florenceville, Hartland, and terminate in the vicinity of the intersection of the Trans-Canada Highway/Route 550 (Connell Road) in the town of Woodstock.

The proponent of the project is the New Brunswick Department of Transportation that will oversee the construction and operation of this road project.

Application of federal and provincial environmental assessment processes

The proposed Project is "project" as defined under the Canadian Environmental Assessment Act (CEAA) and "undertaking" as defined in the New Brunswick Environmental Impact Assessment Regulation. Given the fact that the federal government will be funding 50% of the project through the CSIF program, the project will require an environmental assessment pursuant to CEAA (funding "trigger" pursuant to Section 5 (1) (b) if the Environmental Assessment determines that the project has significant adverse environmental effects, Transport Canada may choose not to support the project or may refer the project to a panel review. Transport Canada, which will be responsible for the attribution of this funding through the Infrastructure Canada, will be a responsible authority for the application of CEAA. Transport Canada will consult fully with Infrastructure Canada during the process so that Infrastructure Canada can also address any obligations as a Responsible Authority in respect to this project. Fisheries and Oceans Canada (DFO) determined that some of the larger watercourse crossings required for the highway project may require approvals pursuant to section 5 (1) of the *Navigable Waters Protection Act*. Additionally, the construction of some of the watercourse crossings may result in the harmful alteration, disruption, or destruction of fish habitat and may require authorizations pursuant to section 35 (2) of the *Fisheries Act*. Both of these regulatory requirements are included in the CEAA, *Law List Regulations*. DFO is responsible for the delivery of these authorizations and as such, DFO will also be a responsible authority for the application of the CEAA. The Responsible Authorities agreed that Transport Canada would be the lead RA.

Since this project involves the construction of an all-season public highway which will be more than 50 km in length and which will be located on a new right-of-way, it will require the conduct of a comprehensive study as specified by section 29 (b) of the *Comprehensive Study List Regulations*.

Transport Canada and Fisheries and Oceans have notified the New Brunswick Department of Transportation of the application of CEAA. Both responsible authorities have agreed to delegate the conduct of the environmental assessment and the preparation of the comprehensive study report to the New Brunswick Department of Transportation, pursuant to subsection 17(1) of the CEAA.

The proponent of the project will have to provide a draft of the comprehensive study report to Transport Canada, which will transmit the report to other federal and provincial authorities for review and comments and will ensure that the proponent responds adequately to those questions and comments. Prior to finalizing the report, both

responsible authorities will have to ensure that they are satisfied with the mitigation measures and recommendations. proposed, and the conclusion of the report. As well, the proponent must ensure that the latest versions of the NBDOTs *Environmental Protection Plan* and *Environmental Field Guide* are followed and referenced in the final CSR. The final report will then be transmitted to the Minister of the Environment and the Canadian Environmental Assessment Agency who will manage a public consultation to obtain comments on the report. Following this consultation, the Minister will determine, pursuant to section 23 of the CEAA, whether the project requires further assessment through a mediation or panel review, or whether the responsible authorities can provide the funding and federal permits which would allow the project to proceed.

Pursuant to the *Federal Coordination Regulations* under CEAA, the following federal departments have indicated that they can provide expertise in the review of this environmental assessment: Environment Canada, Natural Resources Canada, and Indian and Northern Affairs Canada.

Provincially, the Technical Review Committee (TRC) of the New Brunswick Department of the Environment has reviewed the project registration information and provided the proponent with a list of information requirements. It has indicated that the issues and questions identified should be addressed during the conduct of the CEAA comprehensive study report. The TRC further indicated that they wish to review the draft of any iterations of the comprehensive study report as it becomes available. Following a review of the final comprehensive study report, a provincial Environmental Impact Assessment Determination will be issued on the project.

Scope of the project

The scope of the project refers to the various components of the proposed undertaking that will be considered as the project for the purpose of the environmental assessment. The scope of the project must include the principal undertaking and any accessory activities or works that are directly linked to, or interconnected with, the construction and operation of the principal project. The principal project is the one for which a federal attribution is being exercised. For this project the funding which is to be provided by the Office of Infrastructure relates to the entire construction of the highway between Perth-Andover and Woodstock.

The scope of the project is therefore defined as: the construction, operation and maintenance of the 70 km highway to be constructed between Perth-Andover and Woodstock and any required ancillary works associated with those phases. Specifically the scope of the project includes the construction, operation and maintenance of all required interchanges, new road connections, modifications to existing roads to ensure proper integration with the new highway, watercourse crossings and bridges, modification, relocation or removal of any existing structures, operation/closure/restoration of borrow areas, waste rock and storage areas, and if required, the construction and operation of rest areas and weighstations. The scope of the project does not include the decommissioning (with the exception of temporary

structures during construction) of the highway as this is not currently contemplated. The scope of the project does not include the transportation of personnel or materials to the project location for either construction or operation. The scope of the project does not include the manufacture of project materials (e.g., culverts, pre-cast bridge elements, etc.) that are manufactured at existing facilities that exist or operate irrespective of this project.

Public Involvement

It is recognized that the proponent, in designing its project, has conducted several consultation sessions with the public most likely to be directly affected by the project. The proponent is encouraged to continue such consultations and to inform the affected individuals and communities of the progress of the project and of any modifications to the project as well as measures designed to mitigate the potential environmental effects of the project.

In addition, during the conduct of the environmental assessment, the proponent is encouraged to consult with special interest groups from within New Brunswick that may have interests in the protection of specific environmental components that may be affected by the Project. These groups should be provided with information on the project and given an opportunity to express specific concerns and to provide their views on alternatives means of carrying out the project and appropriate mitigation measures.

First Nations Involvement

In addition to consulting the general public, the proponent is required to contact First Nation representatives to inform them about the project. To the extent that it can be identified the proponent shall make efforts to work with First Nations to identify any current use of land and resources for traditional purposes by Aboriginal persons that may be affected by the project. The First Nations that may be affected should be given an opportunity to express their views about the project and should be provided with an opportunity to participate in the development of measures to mitigate potential environmental effects of the project. Indian and Northern Affairs Canada (INAC) is to be contacted for the specific First Nations Bands that need to be consulted.

Part 1 CONTENT OF THE COMPREHENSIVE STUDY REPORT

1.0 Introduction

1.1 Project Overview

This section is to introduce the reader to the comprehensive study report and to the proposed project. The intent of this section is to provide context rather than description since a more detailed description of the project will follow. The proposed project should be briefly described, including location, project components, associated activities, scheduling details, cost, and other key features. The project should be described in the context of the overall completion of the Trans Canada Highway twinning projects. This section should also identify the project proponent.

1.2 Purpose and Need for the Project

In recognition of the fact that the project has may cause adverse environmental effects, this section shall discuss the purpose of the project and the public need for it.

The proposed project will be designed to achieve certain specific objectives. The objectives should be described.

1.3 Regulatory Context

Describe why the environmental assessment is being carried out, including which triggers have led to it. This section should also describe the regulations, acts, policies and plans (e.g. land or resource use) that have a bearing on the project. In this case the project is being assessed under more than one project review process (federal and provincial), the different jurisdictions and processes involved should be listed.

2.0 Project Alternatives

2.1 Alternatives to the Project

This section of the Report shall describe functionally different alternatives to the Project. This discussion shall address but not necessarily be limited to other modes of transportation, upgrading of existing roadway and the null (do nothing) alternative. The feasibility of alternatives to the project should be discussed and their ability to meet the purpose and need for the Project should be considered. The discussion should include some consideration of the environmental implications of selecting the proposed project over other alternatives, including the a number of more key environmental effects of any such alternatives.

2.2 Alternative Means of Carrying Out the Project

This section of the report should outline the alternative means of carrying out the project that are technically and economically feasible and that can reasonably meet the project objectives, including the alternative that is preferable from an environmental perspective. To that end, the analysis should evaluate the preferred alternative and at least one other alternative route that is technically and economically feasible. The process for selecting alternative routes should be described, including the engineering, environmental, and socioeconomic constraints that were considered.

Specifically this section should describe the process taken to select the preferred route alignment and discuss the rationale/support for selecting the preferred alignment. A map should show the preferred alignment, alternate alignments that were considered, and environmental constraints used in the analysis. The proponent should describe any alignment refinements that resulted from public and special interest group consultation.

For significant watercourse crossings, indicate any alternative means of carrying out the crossings that were considered. Provide the rationale for selecting the preferred methods. Regulatory requirements may constrain the alternatives that are feasible or permitted. If this is the case, it should be clearly indicated in the report. If the final design of some of the watercourse crossings are not yet known, the proponent will need to describe in more detail, each potential watercourse crossing technique that may be used. The potential environmental effects associated with each technique, benefits and disadvantages, and the mitigation measures that would be associated with their implementation should also be described. The reader should clearly understand which techniques would be used in what circumstances.

Where appropriate, site location and design alternatives for ancillary facilities that are technically and economically feasible should also be presented. Note: this is required more for the key aspects of the project, not the ancillary facilities.

Alternatives should be listed and described in sufficient detail so that the environmental effects associated with each alternative and the rationale for selecting the preferred ones are apparent to the reader. The criteria for the selection of the alternatives should be identified, together with the importance attributed to each criterion. The selection of the preferred alternative(s) must be based on a clearly described method that comprises at least the following criteria :

- the ability to meet the purpose of the project
- option must be technically, legally and economically feasible
- the ability to limit the scope of the adverse effects on the natural (e.g. avoidance of wetland areas, environmentally sensitive areas, and significant habitat for migratory birds and species of special conservation concern) and human environment and to maximize the positive environmental effects

3.0 Description of Project and Activities

This section of the comprehensive study report shall describe the project particularly as it is planned to progress through the construction, operation and maintenance phases of its life. The description should also address modifications to existing roads, removal of any existing structures along the proposed highway route, and all proposed ancillary facilities which will be required to construct and operate the highway. In defining the project and describing activities, the comprehensive study report should focus on those project activities that are most likely to lead to environmental effects. The project description is limited to the preferred alternative means of carrying out the project as determined in Section 2.2.

The detailed description of the project should include a description of the following project components and activities:

- Location and ownership of land affected by the different project components. A location map should be provided showing the highway alignment, major existing infrastructure, affected and adjacent land uses, waste disposal areas, borrow areas and any important environmental features;
- Design features of the project (traffic operating speed, traffic volume, safety features, links to existing road infrastructure, how the environment has influenced the design of the project e.g. grade of slopes, flooding considerations);
- Construction, installation and operation of ancillary facilities such as rest areas, weigh scales, and weather monitoring equipment as applicable;
- Site preparation and clearing (vegetation, soil and rock removal, associated disposal or storage methods, removal or modification of any existing structures, infilling, location of borrow pits and quarries, blasting activities);
- Acid producing bedrock. Rock types in the project areas and their associated potential for acid producing should be provided. Provide the location and an estimate of the volume of net acid producing bedrock to be disturbed, if any;
- Construction and demolition waste disposal (in accordance with the provincial *Construction and Demolition Debris Guidelines*);
- Forest clearing, recovery and elimination of wood wastes for all project areas;
- Cut and fill (volume, source, transportation, storage and disposal);
- All watercourse crossings, and any water diversions and channel realignments;
- All wetland crossings that cannot be avoided,
- Proposed artificial wildlife corridors;
- Use, transportation and storage of hazardous materials and bulk materials required to complete the project (including paving materials);
- Equipment receiving, handling and storage areas;
- Machinery and fuel storage;

- Construction methods, scheduling details (timing, frequency, duration of project activities and components);
- Types of maintenance required under normal conditions and maintenance/emergency repairs anticipated under extreme weather conditions; and
- Decommissioning plan shall be provided for all structures that are of a temporary nature, including : access roads, borrow areas, petroleum storage areas, equipment receiving, handling and storage, disposal sites.

It may be difficult to separate project components and activities from mitigation since many mitigation measures are sometimes part of standard practice. Include those standard mitigation practices that are applied regardless of location as part of the project description in this section. Those mitigation measures that are site or project-specific should be included in the section on mitigation.

4.0 Existing Environment

The purpose of this section is to describe the environment that could potentially be affected by the project. The existing environment shall be described in sufficient detail and to the extent necessary to support the evaluation of potential environmental effects and to develop mitigation that may be required. The section should identify the study area and describe the existing environmental components, their interrelationship and their sensitivity to disturbance. If the data held by government, municipalities, Aboriginal or other organizations (see Annex 1) is inadequate or not representative, the proponent shall complete the description of the environment using inventories carried out in accordance with generally accepted methods. The report should provide all information required to understand or interpret the data (methodology, inventory dates, location of sampling sites, etc.).

The proponent's description of the existing environment should be in sufficient detail to permit the identification, assessment and determination of the significance of potentially adverse environmental effects that may be caused by the project and to adequately identify and characterize the beneficial effects of the project. Where necessary, the proponent is expected to conduct surveys. In terms of wetlands, migratory birds, and species of special conservation concern (including rare vascular plants) in the project area, surveys are to be conducted in accordance with methods acceptable to Environment Canada and the New Brunswick Department of Natural Resources and Energy. If the background data have been extrapolated or otherwise manipulated to depict environmental conditions in the project area, modelling methods and equations shall be described and shall include calculations or qualitative characterizations of margins of error, if and as applicable.

The proponent is encouraged to focus the environmental assessment on the valued environmental components (VECs). This description should include, but not necessarily be limited to those VECs, processes, and interactions likely to be affected by the proposed project as identified by the public, government departments and agencies,

other interested parties, and the proponent itself. The location of these VECs should be indicated on maps or charts. The proponent should indicate the methods used to identify the VECs, to whom these VECs are important, and the rationale and the justification for selecting some VECs while excluding others.

In addition to describing VECs, the proponent must provide baseline information on the existing conditions of the VECs. In providing this information, the proponent should present a sufficient time-depth of data and information to establish norms, trends, and extremes, to the extent that such information is available or necessary to understand the potential environmental effects of the project. The proponent should comment on the quality and reliability of these data and their applicability for the purpose used, and clearly identify gaps, insufficiencies, and uncertainties, especially those that should be remedied for follow-up purposes.

The VECs considered by the proponent should include, but not necessarily be limited to, the following:

- Moose and moose habitat
- Species of special conservation concern¹
- Fish and fish habitat
- Agricultural land
- Appalachian Hardwood Forest
- Migratory birds
- Wetlands
- Water quality
- Atmospheric quality

The description of baseline condition should include information on all identified VECs and the following environmental components:

Physical Environment

- a) bedrock geology and hydrogeology (including information on the potential for acid producing bedrock);
- b) surface geology and soils;
- c) sensitive slopes, and stream-banks;
- d) areas of ground instability and flood zones;
- e) local microclimate and regional climate change and meteorology;
- f) special, sensitive, or unique geological or landform features (e.g. wetlands, stream and riparian zones within a minimum of 500 m of the centreline);
- g) location and condition of existing contaminated sites, including all known landfills and points of sewage contamination within the study area;

¹ species of special conservation concern include species listed by the Committee on the Status of Endangered Wildlife in Canada [COSEWIC], identified as S1, S2, and S3 by the Atlantic Canada Conservation Data Centre [AC CDC], designated in provincial listings, or considered to be "sensitive".

- h) water quality; important physical and chemical parameters of ground and surface waters, at the sub-watershed and watershed level including:
 - baseline water quality and quantity survey data;
 - existing uses and users of the water resources; and,
 - estimated salt loading data for the area.
- i) ambient noise levels should be characterized for various locations along the corridor where traffic noise on the proposed highway could be an important environmental effect on the human environment and sensitive wildlife species.
- j) atmospheric conditions;
 - Describe the air quality to include, but not necessarily be limited to, wind speeds and directions, precipitation amounts and precipitation chemistry. Attention is to be paid to ambient particulate matter (PM) levels in areas where construction, operation and maintenance activities may exacerbate existing conditions. (Note: PM less than or equal to 10 microns, and PM less than or equal to 2.5 microns are toxic substances under the *Canadian Environmental Protection Act*).
 - Describe the weather patterns along the proposed route as they relate to highway construction, operation, and maintenance, taking into account extreme conditions that could be encountered and climate change scenarios as applicable. Include how snow, ice and wind conditions may be expected to change with geographic conditions and seasons, and how these relate to the proposed project.
 - Describe what Probable Maximum Precipitation levels are used and how they relate to the proposed project

Biological Environment

- a) vegetation of aquatic, riparian and terrestrial environments, including a forest inventory (species, areas, volumes and commercial value), focusing particular attention on species of special conservation concern or species likely to be designated as such and to species of economic and cultural importance;
- b) wildlife species (migratory, terrestrial, semi-aquatic, and aquatic species) and their habitat (in terms of abundance, distribution, diversity, productivity and health), focusing particular attention on species of special conservation concern, species of recreational and commercial value, and species used by Aboriginal communities for purposes of food, social and ceremonial purposes. Surveys and investigations required to supplement the available data shall be completed for migratory birds including forest birds and waterfowl. The methods for these studies must be acceptable to appropriate provincial departments and Environment Canada;
- c) wetland within the predicted zone of influence, identify the location, size and class of and conduct a wetland evaluation (Ms. Lee Swanson, NBDNRE, at (506) 453-2440 can provide a digital wetlands inventory). The true ecosystem value and function of each wetland shall be examined through on-site investigations using comprehensive valuation methods that assess component, functional and attribute values. Field surveys and investigations required to supplement the available data shall be completed in a manner that is acceptable to the appropriate provincial departments and Environment Canada. The Federal Government's goal for No Net Loss of wetland function, as described in the Federal Policy on Wetland Conservation and

related Implementation Guide, will form the basis for all evaluations of wetlands which will be potentially affected directly or indirectly;

- d) fish and fish habitats found in all watercourses directly and / or indirectly associated with the project must be assessed. These assessments must be based on the established 'DNR&E / DFO Stream Survey and Habitat Assessment' methodology.

Socio-economic Environment

- a) the social, economic and cultural setting of the project area;
- b) population and community distribution;
- c) current attitudes and concerns of the local and regional population, highway users and recreational facility users and others towards the project;
- d) planning strategies or proposed development within the project area pertaining to land or water use;
- e) present and potential conflicts or restrictions in terms of existing land use patterns (e.g. aboriginal persons, contaminated sites, utilities);
- f) historical, archaeological, cultural and paleontological sites of the area (A detailed assessment, including field investigation, of potential environmental effects on these sites to be completed by a licensable archaeologist)
- g) architectural heritage, (provide additional information on the 21 buildings that will be impacted by the project – contact Mr. Richard Phillips, Heritage Officer at (506) 453-8125 for information requirements);
- h) protected areas such as parks, sanctuaries or wetlands, whether established or proposed
- i) level and value of recreational, educational, scenic and other social uses of the project area, (e.g. use of parks, fishing, hunting, trapping, trails-specifically the International Appalachian Trail).

Note: The following environmentally Significant Areas are located near the proposed project

- Saint John River and Estuary;
- Perth-Andover Hardwood Forest;
- Summerfield Hardwood Forest;
- Ketch Lake;
- Clarks Brook Bog;
- Woodstock-Meduxnekeag Bridge;
- Moody (Iron Ore) Hill Deciduous Stand;
- Payson Lake;
- Upper Woodstock Hardwood Slope;
- Highway 95 Hardwoods; and
- Bedell Settlement Woods.

5.0 Public Participation

Each aspect of the public involvement program should be identified and the results documented in this section of the comprehensive study report. The Proponent should discuss how it has consulted with residents and organizations that are likely to be affected by the Project, and other parties who may be interested in the Project. Describe who was consulted, the objectives of these consultations, the methodology used, and the results. The result of the public participation and information sessions must detail how public comments were addressed, including any modifications and additional mitigation measures or commitments that resulted from these consultations.

A separate sub-section should provide the same type of information specifically to document the First Nations consultations.

Expert Department Consultation

Provide a listing of expert federal/provincial departments/agencies consulted during the environmental assessment. A record of consultation with the federal/provincial departments/agencies, issues raised by them and how these were addressed, as well as discussion of any unresolved issues raised during consultations should be provided in this section of the report.

Possible Groups to consult

The following are some of the groups that should be consulted:

- Meduxnekeag River Association - Mr. Stephen Wells, (506) 325-1100
- Ducks Unlimited
- Nature Trust of New Brunswick – contact at NBDOE is Nelda Craig (506) 457-4846

6.0 Environmental Effects, Proposed Mitigation and Significance of Residual Effects

This section should:

- a) identify any adverse environmental effects that the project will cause to the identified VECs, and the effects of these changes on human health, socioeconomic conditions, physical and cultural heritage and on current use of lands and resources for traditional purposes by aboriginal persons.
- b) identify cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out, and the environmental effects of possible malfunction or accidents
- c) describe and justify the proponent's plans to mitigate the adverse environmental

- effects of the project and assess the likely effectiveness of those plans;
- d) identify any residual environmental effects (including the permanent loss of habitat) of the project, and the proponent's plans to compensate for these; and,
 - e) assess the residual environmental effects and their significance.
 - f) consider the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.

For ease of review, the CSR should include a table setting out the environmental effects, proposed mitigation, and residual adverse environmental effects.

Methods

This section should include a description of the methods used to develop the strategy for investigating the interactions between the project and each VEC, and the methods used to predict and evaluate the potential environmental effects of project activities. If a detailed description of a particular method (such as a computer model used to predict emission dispersion or assimilative capacity) is required, it should be placed in a supporting document.

These methods will be used to judge the validity and accuracy of the predicted environmental effects. For quantitative modeling and predictions, a discussion of the model assumptions, the data quality and the confidence levels should be included in this section.

Predictions may be made by other than technical scientific or engineering methods. Consultations or the incorporation of traditional knowledge may have played a role in determining and predicting environmental effects. If so, those methods should be documented here.

Available guidance which is to be considered in the assessment of environmental effects is outlined in Appendix 1.

Environmental Assessment Boundaries

This section should define the environmental assessment boundaries. By defining the spatial and temporal boundaries of the project (e.g., project footprint, zones of influence, and schedule) and the VEC (e.g., distribution of the affected population in time and space), the proponent will establish a frame of reference for identifying and assessing the environmental effects associated with the project. The environmental assessment boundaries should be defined for the project and each VEC.

Describe rational/methodology in defining the zone of influence boundaries, both special and temporal.

In describing and predicting the environmental effects of the project, the proponent shall cover the period from the start of any pre-construction activity associated with the

project through construction, operation, including maintenance and repairs.

The report should contain a rationale for all boundaries and scales chosen.

Environmental Effects

In predicting and evaluating the potential adverse and beneficial environmental effects of the project, the proponent should provide substantial detail and state clearly what elements and functions of the environment may be lost or enhanced, where, how much, for how long, and with what overall effect. The proponent should characterize the magnitude, geographic extent, duration, frequency, reversibility and ecological/socio-cultural and economic context for each environmental effect to assist in the evaluation of the significance of those environmental effects.

The environmental effects of the project on the existing physical, biological and socio-economic environments should be identified and assessed, the proposed mitigation and compensation measures described, the residual environmental effects and their significance identified and assessed. The key focus of this assessment should be on the VECs identified in the previous section. However, the proponent should also ensure the analysis of environmental effects includes a consideration of the following:

- a) releases of pollutants during all phases of the scoped project such as acid rock drainage, and including any substances considered to be toxic under the *Canadian Environmental Protection Act (CEPA)* such as road salt and particulate matter;
- b) water quality and quantity, including groundwater (particularly the effects on wells that may result from blasting activity within 500 m of the proposed RoW), runoff, and surface water in the watershed; Note: decommissioning of wells must be done in accordance with the *Water Well Regulation* of the NB Clean Water Act.
- c) fish and fish habitat, especially at watercourse crossings (impairment of ecosystem function, or changes in productivity);
- d) other water users/supplies such as hatcheries;
- e) vegetation, wildlife and birds and their habitat, with attention to species of special conservation concern or species likely to be designated as such and species of economic and cultural importance (impairment of ecosystem function, or changes in productivity);
- f) atmospheric conditions and modification of local air quality, its potential effect on health, microclimates and climate (e.g. particulates, greenhouse gases) within the study area as affected by the project during peak traffic and other periods;
- g) noise and possible increase of background noise levels from highway construction activity and from traffic on sensitive wildlife species.
- h) changes in greenhouse gas emissions resulting from deforestation and from loss of soil carbon. Discuss the potential loss of carbon sinks (e.g. immature trees). A recommended source of information to support these calculations is the report,

"Estimating the Carbon Losses from Deforestation in Canada" by D. Robinson, W.A. Kurz, and C. Pinkham, which is available at www.nccp.ca/NCCP/pdf/Deforest_Canada.pdf.);

- i) drainage patterns, erosion, and stream flows;
- j) slope stability and flood zones;
- k) functional changes in wetlands;
- l) adverse economic changes including, but not limited to, loss of property values and the loss of revenue caused by a change in the environment (trapping, hunting, recreational potential, etc.);
- m) changes in lot size, proximity of houses and buildings and set backs from the new right-of-way, required modifications to building access, required community or household relocation and expropriation, and property splitting including changes to the size/area of land "remnants" in the context of future development potential.;
- n) changes in quality of life caused by the construction, operation and modification of the project including, but not limited to, issues such as, noise, dust and traffic levels, lowered air and water quality, alteration of visual and topographic characteristics of the area;
- o) present and future land and water use, including, changes in aesthetics and/or economic, education and recreational opportunities caused by the construction, operation and modification of the project;
- p) agricultural lands (in terms of lost area, lost revenue, required modification of agricultural drainage, access issue to the land and for machinery, and for farm animals);
- q) productive woodlots (lost of forested area, productivity and economic value);
- r) existing infrastructure, such as existing roads, electrical transmission lines, existing rights-of-way, distances from hospital and public protection services;
- s) archeological, historical, cultural, and scenic sites;
- t) temporary and permanent restrictions on land use during construction, operation and modification;
- u) local and regional transportation pattern shifts including, but not limited to shifts in traffic flows, average speeds, timing of traffic, sources and destinations, accident rates, induced traffic and vehicle mix;
- v) navigation where the highway will cross navigable watercourses; and
- w) current use of lands and resources for traditional purposes by Aboriginal people.

To the extent that is possible, the discussion of these environmental effects and their proposed mitigation should give full consideration to community knowledge of the environment and of appropriate and effective mitigation measures.

Mitigation

The proponent should describe general and specific measures intended to mitigate the potentially adverse environmental effects of the project. Mitigation is defined as the

elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means.

Mitigation measures should be consistent with the requirements of all relevant legislation, regulations, guidelines, policies, management plans, specifications, and best management practices (including those identified in Annex 1). Mitigation should be considered in a hierarchical manner with environmental effects avoidance measures identified first, reduction measures second and compensation last.

Mitigation measures are to be outlined for all VECs within the physical, biological and socio-economic environment where required. All proposed components of mitigation should be described by phase, timing and duration. Information must be provided on methods, equipment, procedures, and policies associated with the proposed mitigation or restitution. Standard management strategies are to be identified and established where none exist. The proponent should discuss and evaluate the effectiveness of the proposed measures and assess the risk of mitigation failure and the potential severity of the consequences. Information should be provided on similar mitigation methods used with similar projects and the degree of success achieved.

Where appropriate, The proponent should indicate what other mitigation measures were considered (including the various components of mitigation) and explain why they were rejected. Trade-offs between cost savings and effectiveness of the various forms of mitigation should be justified. The proponent should identify who is responsible for the implementation of these measures and the system of accountability

Compensation

As part of the proposed measures to mitigate potentially adverse environmental effects, the proponent should outline its compensation plans and policies for addressing adverse residual environmental effects, including compensation for:

- a) loss of fish habitat in accordance with Fisheries and Oceans Canada's policy for the Management of Fish Habitat;
- b) damage caused by the proponent's activities to the environment, to property, or to the land and resource use of others; and
- c) loss of wetland function in accordance with the Federal Policy on Wetland Conservation where avoidance of impacts is not possible.

The proponent should also include a discussion of past compensation measures taken for other infrastructure projects, and the successes of such measures.

Significance

The report should contain a detailed analysis on the significance of the potential adverse residual environmental effects it predicts. Residual effects include the adverse

effects that may remain at each stage of the project after proposed mitigation or enhancement measures are implemented, including emergency response and contingency plans. It should contain sufficient information to enable the reviewers to understand and review the proponent's judgment of the significance of environmental effects. The proponent should define the terms used to describe the level of significance. The proponent could use the following criteria to assess the significance of effects:

- a) magnitude;
- b) geographic extent;
- c) timing, duration and frequency;
- d) degree to which effects are reversible or can be mitigated;
- e) ecological and social/cultural context;
- f) probability of occurrence;
- g) the capacity of renewable and non-renewable resources (including but not limited to recreational areas) to meet the needs of the present and those of the future; and,
- h) standards, guidelines or objectives.

The determination of significance and likelihood of significant residual environmental effects are at the core of the decision about the project. It will dictate whether a responsible authority can take a course of action with respect to the project, or whether additional consideration of the project is needed through public review. For this reason, the CSR must include clear statements of whether the adverse environmental effects, taking into account any mitigation measures, are significant, not significant or uncertain. It should be noted that a determination of significant environmental effects or uncertainties (associated with the significance) would lead to a public review of the project through a mediation or a panel review as specified by section 23 of the *Canadian Environmental Assessment Act*.

In the comprehensive study report, the methods used to determine significance should be clearly documented and the results of that determination should be easily linked to these methods. These methods should include not only an analysis of the results and professional judgment, but also consultations with both the public and appropriate experts. This section of the report should document the assumptions that entered into the determination of significance and where environmental effects are predicted to be significant, the uncertainty that surrounds those predictions should be clearly stated. If those results or predictions are later found to be incorrect, the determination of significance may no longer apply. The report should convey the level of confidence associated with the predictions since this reflects upon the validity of the significance determination. The report should also note dissenting opinions.

Effects on the Sustainable Use of Renewable Resources

The proponent should include a consideration of the potential adverse environmental effects on the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future. The proponent

should clearly identify the renewable resources that may be affected by the project and the criteria used in determining whether their sustainable use will be affected significantly.

The sustainable use of renewable resources is closely linked to the consideration of cumulative environmental effects. For example, an adverse effect on the sustainable use of a renewable resource, such as a fishery, may be caused by a cumulative environmental effect of a project, or it may be a cumulative environmental effect in its own right.

Possible Malfunctions or Accidents

The proponent should identify and describe the probability of possible malfunctions or accidents associated with the project, and the potential adverse environmental effects of these events. The description should include the safeguards that have been established by the proponent to protect against such occurrences and the contingency procedures in place. Leaks and spills both during construction and operation, collisions and other accidents should be considered.

Effects of the environment on the project

Environmental hazards potentially affecting the project should be described and the predicted effects from these hazards on the proposed project should be documented. This section of the report should discuss the effect the environment may have on the construction and operation phases of the project, including weather and climate elements. Any necessary climate information to validate statements made in the assessment should be provided. Issues such as erosion, wind, floods, severe precipitation events, land or rock slides, unstable soils, seismic events, or soil contamination should be addressed. In addition, the proponent should discuss how the project will address these potential effects in its design considerations. The significance of the effects of the environment on the project should be determined.

A reasonable determination of potential climate change is to be made based on information of past and future trends. One important source of climatological data is Environment Canada's Climate Centre:

Environment Canada
Atlantic Climate Centre
77 Westmorland Street, Suite 400
Fredericton, New Brunswick E3B 6Z3
Phone: New Brunswick: (506) 451-6006
Fax: (506) 451-6010
E-Mail: climate.atlantic@ec.gc.ca

Cumulative Environmental Effects

The proponent should identify and assess the cumulative adverse environmental effects of the project in combination with other past, present projects that will be carried out. The approach and methodologies used to identify and assess cumulative effects should be explained.

Guidance on how to consider cumulative environmental effects in an environmental assessment is provided in the Reference Guide entitled *Cumulative Effects Assessment Practitioners Guide*, Canadian Environmental Assessment Agency, February 1999. Consideration of cumulative environmental effects shall be limited to other projects or activities that are now taking place, or have taken place within the study area since 1981. It also should include future projects that will happen (*i.e.* are currently in the review process, with a high probability of receiving funding) within the next 5 years (before 2008).

The cumulative effects assessment should be focused on, the following VECs:

- Moose and moose habitat
- Species of special conservation concern (including migratory birds) and their habitat
- Fish habitat and water quality
- Agricultural land
- Appalachian Hardwood Forest
- Wetlands

7.0 Follow Up Programs

This section of the report should outline the need for and requirements of a follow-up program. A follow-up program is a formal, ongoing process to verify the accuracy of the environmental assessment of the project and determine the effectiveness of mitigation measures. If the follow-up program identifies unforeseen adverse effects, then the existing mitigation measures should be adjusted or, if necessary, new mitigation or compensation measures should be developed.

In the report, it is important that the objectives of the program be clearly defined and be as specific as possible since they will form the basis for the detailed monitoring and follow-up program that will be designed and carried on after the project is approved. The program should include the establishment of baseline conditions prior to disturbance, which will allow for comparison with the conditions after construction and restoration.

The critical question regarding implementation of a follow-up program is one of uncertainty or unfamiliarity -- in either the analysis and predictions of the environmental assessment, or in the mitigation measures. The assessment must consider, for

example, whether a new modeling technique or an untried mitigation measure introduces a level of uncertainty into the project and, if so, what are the corresponding risks of an inaccurate analysis or ineffective mitigation measure?

This section of the report should provide enough information on the follow-up and monitoring programs to allow the reviewer to determine whether these programs are likely to be effective in meeting the objectives defined above. The focus of the monitoring and follow-up program should be on those potential environmental effects associated with the greatest risk and uncertainty.

The report should identify:

- a) the need for such a follow-up program and its objectives;
- b) how it will be structured including enforcement;
 - the elements of the environment (i.e. air emissions, erosion, habitat use, etc.) that are to be monitored;
 - where monitoring will occur;
 - the frequency and duration of monitoring; and
 - protocols for the interpretation of follow-up results and actions to be taken based on findings.
- a) penalties for non-compliance;
- b) the roles to be played by the proponent, regulatory agencies, and others in such a program;
- c) the sources of funding for the program; and
- d) reporting.

8.0 Conclusion and Recommendation

This section of the report should outline the responsible authorities conclusion about the nature of the project's environmental effects.

One of four conclusions are possible.

1. The project is not likely to cause significant adverse environmental effects, taking into account appropriate mitigation measures, if necessary.
2. The project is likely to cause significant adverse environmental effects that cannot be justified.
3. The project is likely to cause significant adverse environmental effects and it is uncertain whether these can be justified in the circumstances.
4. It is uncertain whether the project is likely to cause significant adverse environmental effects.

The final decision on the project will be made after the Agency and the public have reviewed the comprehensive study report and the Minister of the Environment has made a decision on the next step in the process.

This section should summarize the predicted adverse environmental effects of the project, outstanding issues or concerns, any terms and conditions deemed appropriate, or other aspects of the proposal relevant to the decision.

PART II PRESENTATION OF THE COMPREHENSIVE STUDY REPORT

The comprehensive study report is to be a single stand-alone document that provides sufficient information to allow a decision to be taken on the likelihood of significant environmental effects or the need for further assessment. Enough detail should be included to permit the reader to understand the connections between the project, environmental components, potential effects, mitigation and the conclusions posed in the report.

The report should include a table that cross-references these Guidelines. If additional information is provided to respond to reviewers questions, it should be integrated in the final version of the comprehensive study report. A cross-reference table should be provided with each iteration of the report.

Since the report is intended for public review, the information should be presented in non-technical language wherever possible and appropriate, including a non-technical executive summary. Where the complexity of the issues addressed requires the use of technical language, a glossary defining technical words and acronyms should be included. The proponent shall provide charts, diagrams and maps wherever useful to clarify the text, including perspective drawings that clearly convey what the developed site would look like. Maps shall be of a limited number of common scales to allow for comparison and overlay of mapped features.

The proponent will have to provide 15 copies of a draft of the comprehensive study report to Transport Canada which will potentially be the lead responsible authority for the project. Transport Canada will transmit the report to other federal and provincial authorities for review and comments. The draft comprehensive study report should be submitted to:

Debbie deGrasse
Highway Programs Manager
Transport Canada
Place de Ville, 330 Sparks St.
Ottawa ON K1A 0N5

Upon finalization, the proponent will be required to submit an electronic copy of the report in English and in French, in PDF format, for publication on the CEAA's website. The proponent will also be required to submit 25 copies of the report (in English and in French) for distribution to provincial and federal authorities, for placement on the public registry and in viewing centres.

Annex 1 - DATABASES TO CONSULT

Selection of Published Information and Guidance Related to Migratory Birds

- Atlas of Breeding Birds of the Maritime Provinces (1992)
- Migratory Birds Environmental Assessment Guideline (1998)
- Environmental Assessment Guideline for Forest Habitat of Migratory Birds (1998) (available at www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm)
- Important Bird Areas of Canada (available at www.ibacanada.com/main.htm)
- Atlantic Canada Conservation Data Centre (www.accdc.com)
- Local naturalist groups

Selection of Published Information and Guidance Related to Wetlands

- *Federal Policy on Wetland Conservation and associated Implementation Guide for Federal Land Managers* (available at www.cws-scf.ec.gc.ca/habitat/ramsar/docs/FPWC.pdf and www.cws-scf.ec.gc.ca/habitat/ramsar/docs/FPWCIG.pdf)
- North American Wetlands Conservation Council (Canada) (NAWCCC) *Wetland Evaluation Guide*
- NAWCCC *No Net Loss* implementation guide
- NAWCCC *Wetland Mitigation in Canada* framework
- *Wetlands Environmental Assessment Guideline* (1998) (available at www.cws-scf.ec.gc.ca/publications/eval/wetl/index_e.cfm)
- New Brunswick Wetlands Inventory
- Wetlands of the Maritime Provinces: Revised Documentation for the Wetlands Inventory (1996)

Selection of Published Information and Guidance Related to Toxic Substances and Environmental Quality

- CEPA Toxic Substances and Priority Substances Lists (accessible at www.ec.gc.ca/CEPARRegistry/subs_list/ToxicList.cfm) and related assessment reports (accessible at www.ec.gc.ca/substances/ese/eng/psap/final/main.cfm)
- The following guidelines published under authority of CEPA (accessible at www.ec.gc.ca/CEPARRegistry/guidelines/Guidelines.cfm)
 - Canadian National Ambient Air Quality Objectives
 - Canadian Water Quality Guidelines for the Protection of Aquatic Life
 - Canadian Sediment Quality Guidelines for the Protection of Aquatic Life
 - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health
- Canada-Wide Standards (available at www.ccme.ca/initiatives/standards.html)
 - EC's EnviroDat database should be included as a source for surface water and

groundwater quality data. Information about this data and contact information are available at EC's EnviroDat Data Archive website (www.msc-smc.ec.gc.ca/climate/data_archives/envirodat/index_e.cfm)

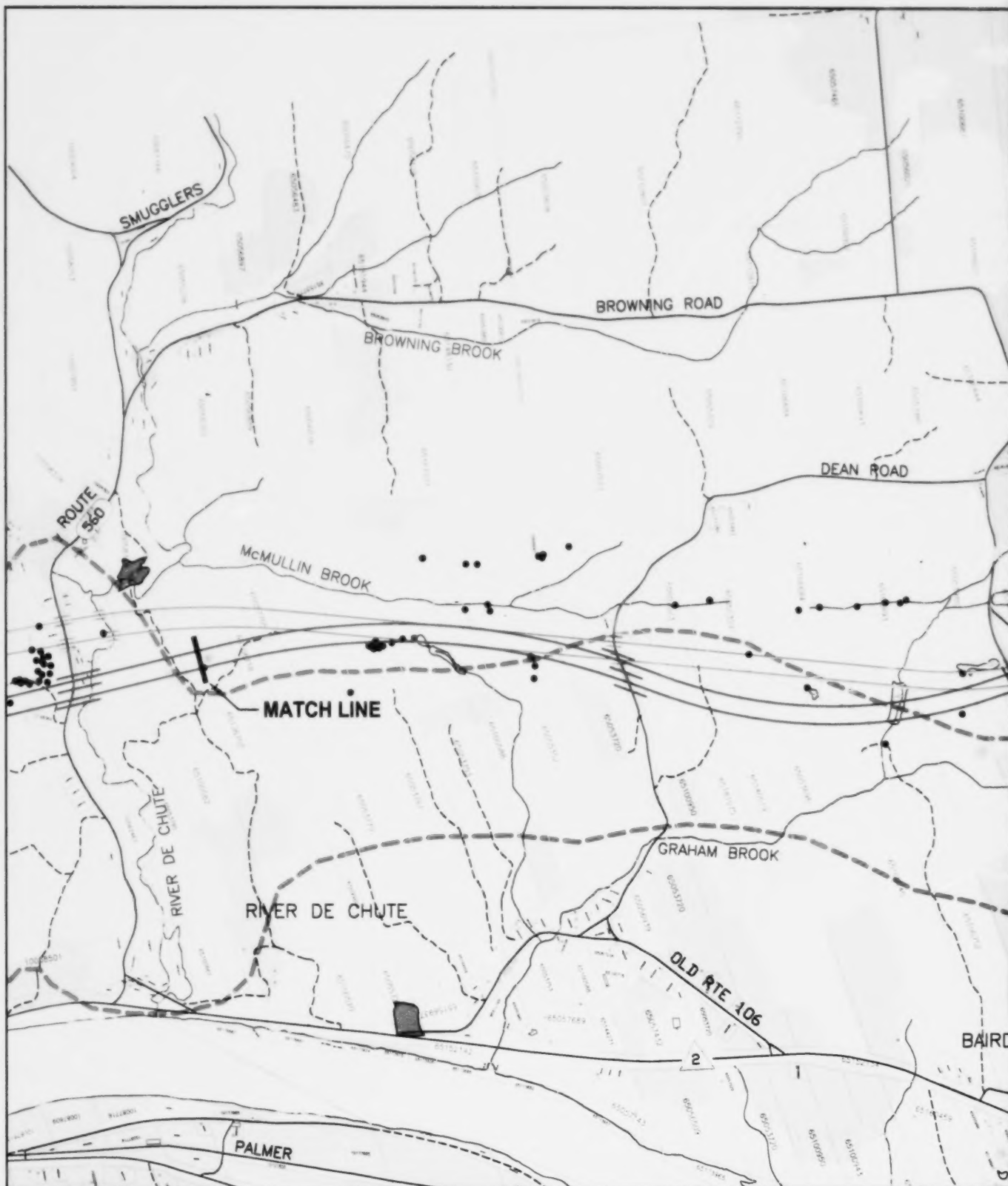
- All sources of information regarding species of special conservation concern including the Atlantic Canada Conservation Data Centre (AC CDC), provincial agencies, and the latest Committee on the Status of Endangered Species (COSEWIC) lists and related species status reports (www.cosewic.gc.ca/eng/sct5/index_e.htm), should be given consideration in the comprehensive study. All species found in the project area which are listed by the COSEWIC, identified as S1, S2, and S3 by the AC CDC, or designated to be at risk by the Government of New Brunswick should be identified for attention in the comprehensive study.
- *Air Quality Monitoring Results in New Brunswick* available from the New Brunswick Department of Environment and Local Government (NB DELG)

National Air Pollution Surveillance (NAPS) Network, which can be obtained from:
Environmental Protection Publications
Environmental Protection Service
Environment Canada
Ottawa, Ontario
K1A 0H3

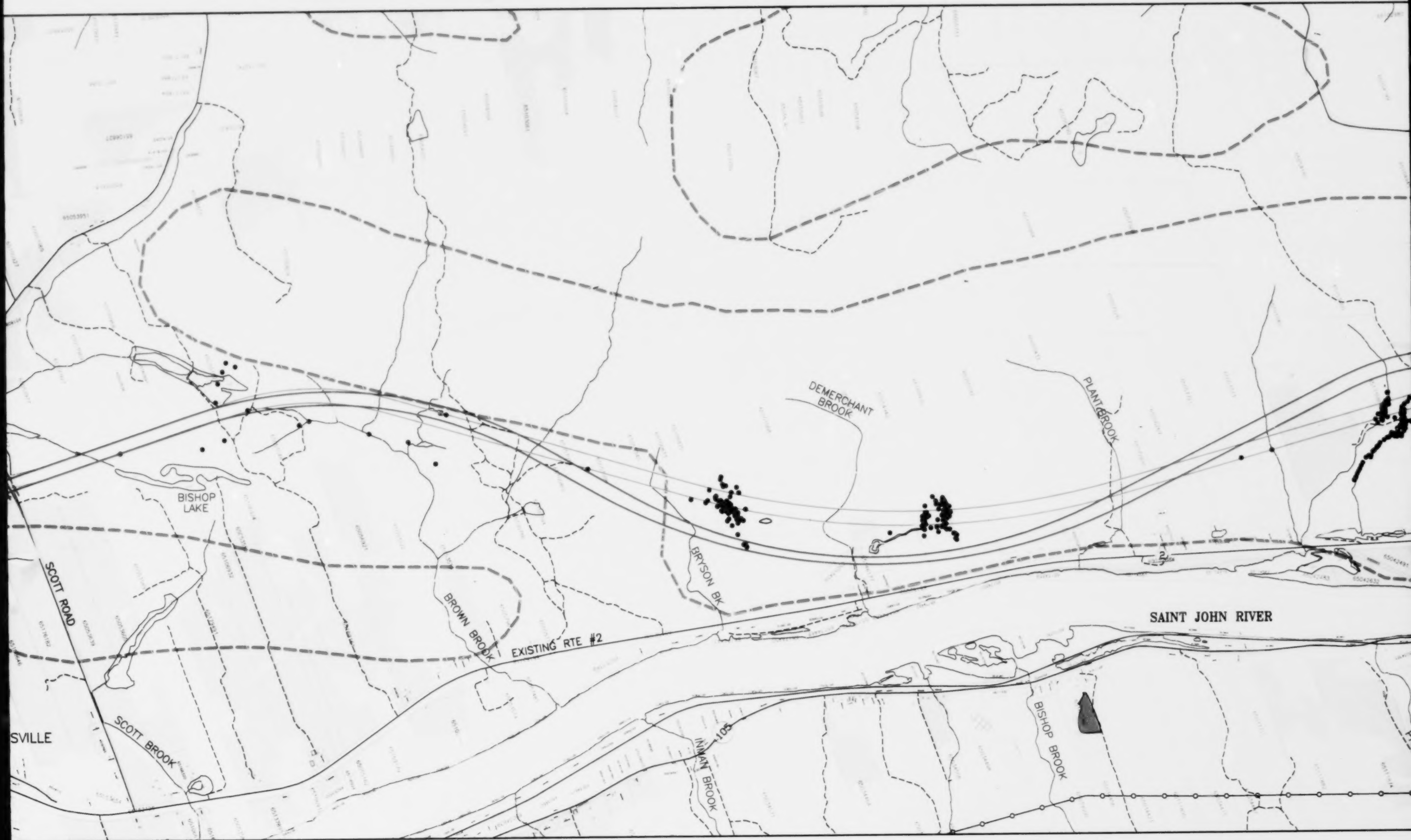
APPENDIX B
PROJECT ALTERNATIVES







* NOTE THAT NOT ALL OF THE COLOUR-CODED ALIGNMENTS (i.e., INITIAL, 1998, 1999, 2003) ARE VISIBLE IN ALL LOCATIONS. THIS IS DUE TO THE OVERLAP OF THE MOST RECENT ALIGNMENT (VISIBLE) OVER THE PREVIOUS YEAR'S ALIGNMENT (NOT VISIBLE). FOR A GIVEN SECTION OF HIGHWAY, VISIBILITY OF THE EARLIER ALIGNMENT INDICATES THAT THE ROUTE WAS CHANGED ALONG THAT SECTION IN THE FOLLOWING ITERATION.





**ALTERNATIVE ALIGNMENTS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03

Scale: 1 : 20 000

Job No.: 14677

Fig. No.: 2.1-A



Jacques Whitford
Consulting Engineers
Environmental Scientists

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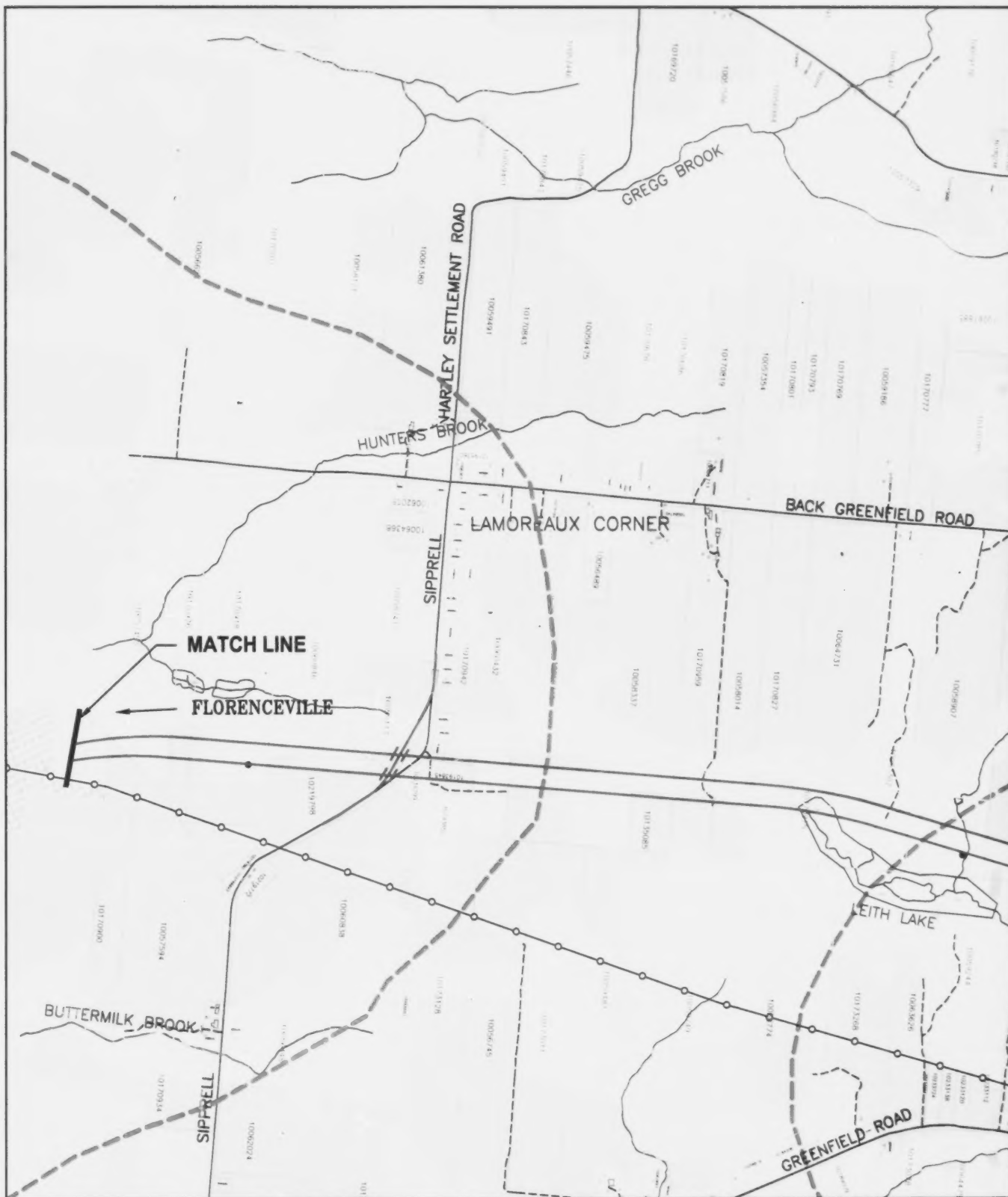


ALTERNATIVE ALIGNMENTS
 NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
 PERTH-ANDOVER TO WOODSTOCK

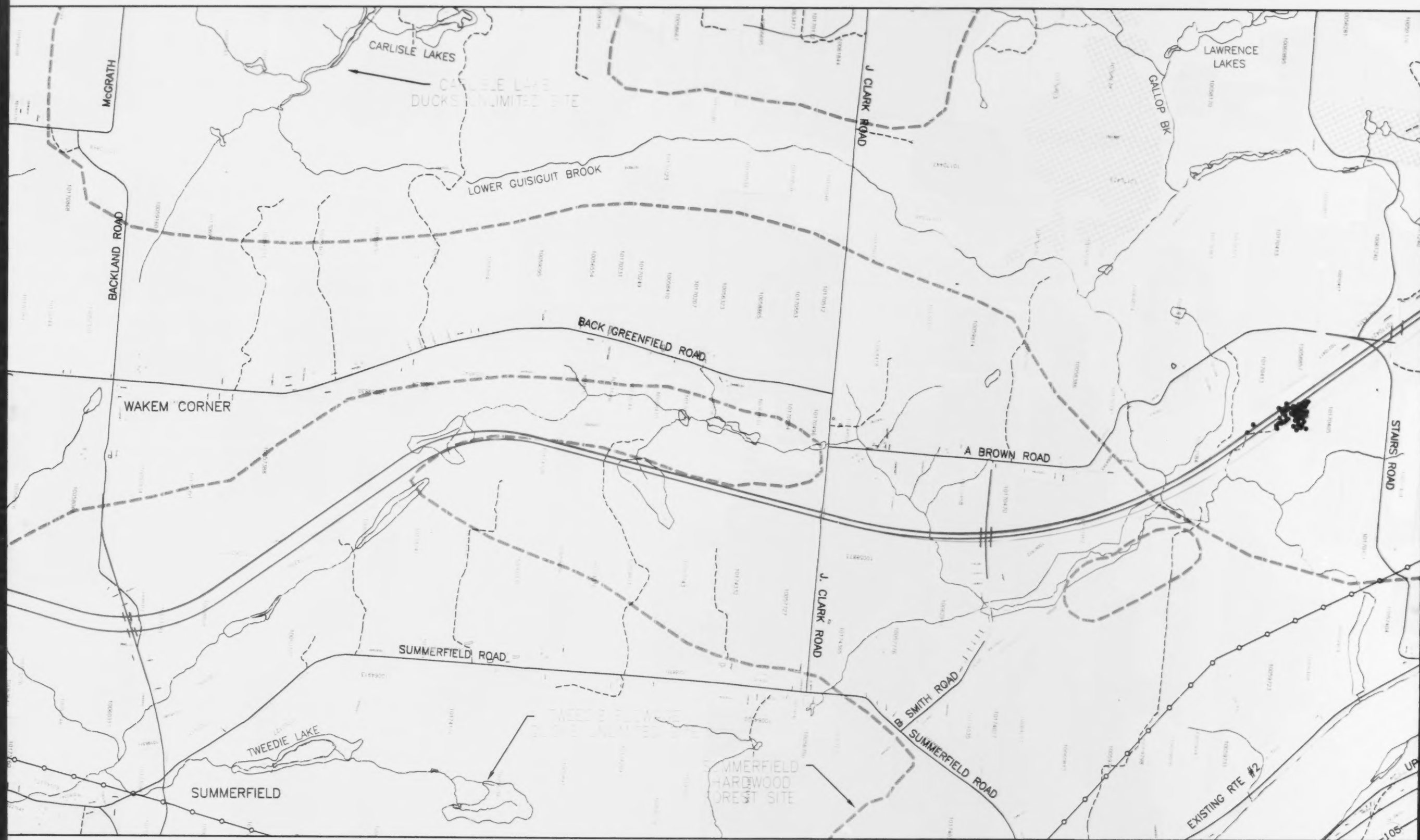
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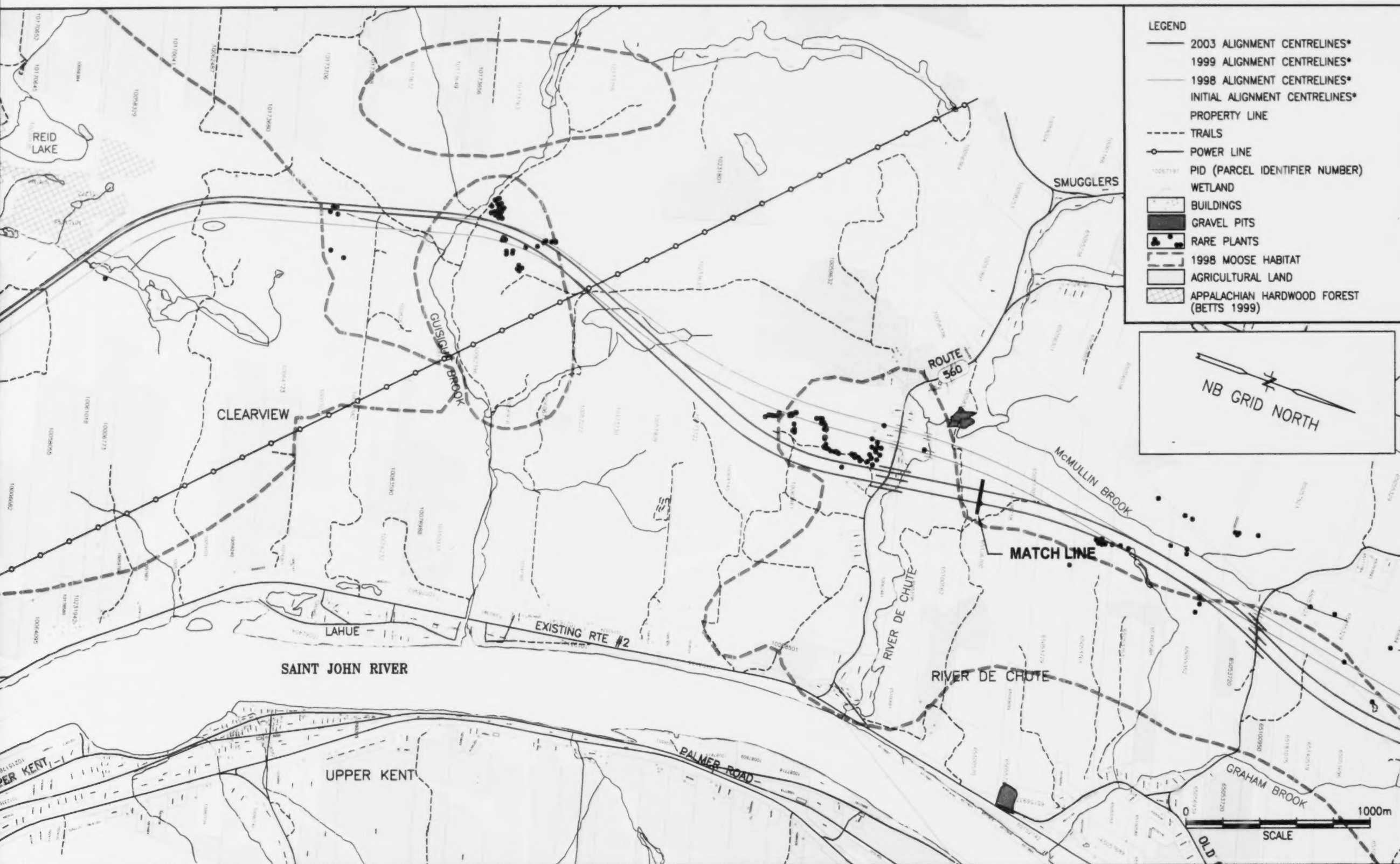
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 Environmental Scientists



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NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

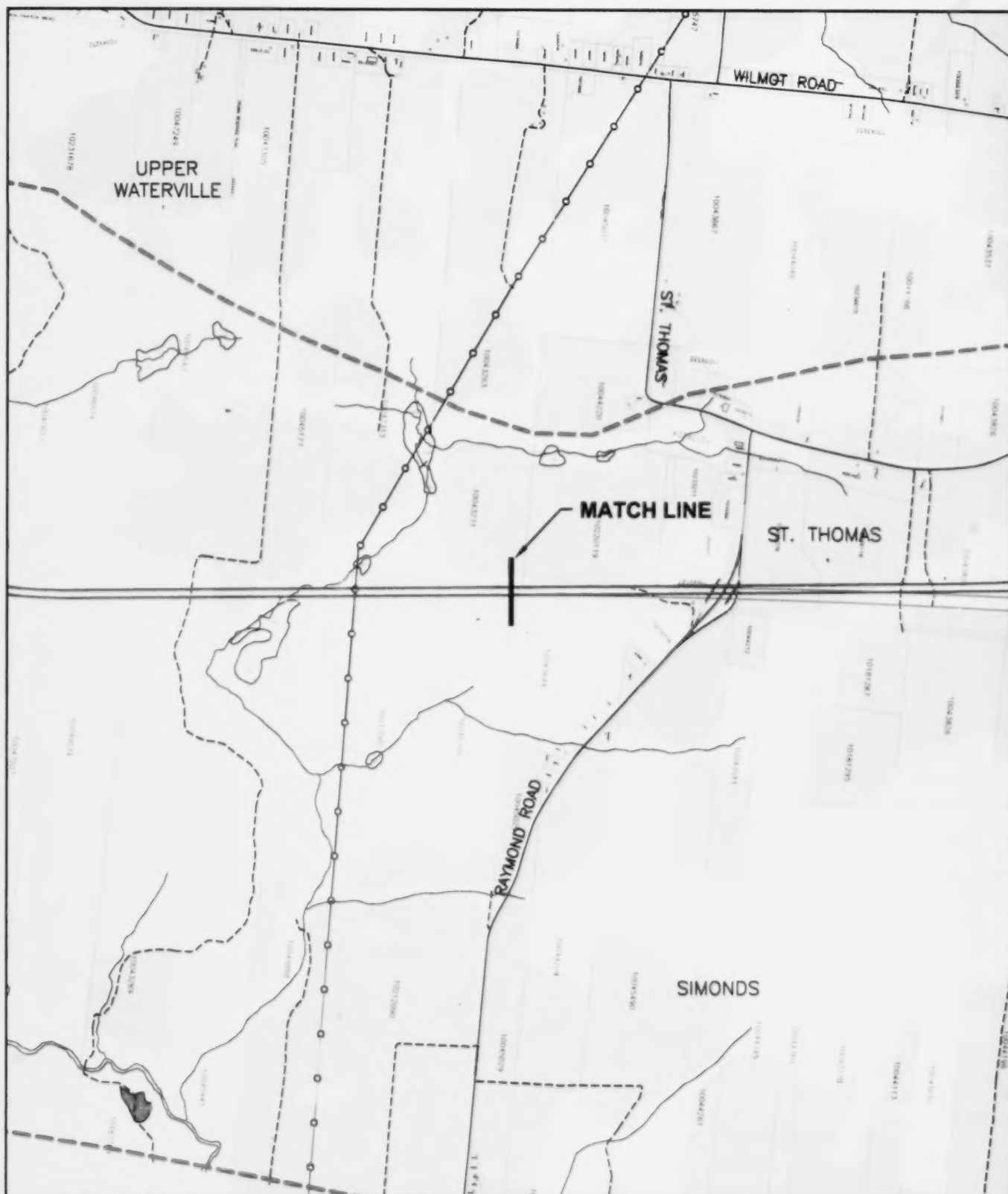
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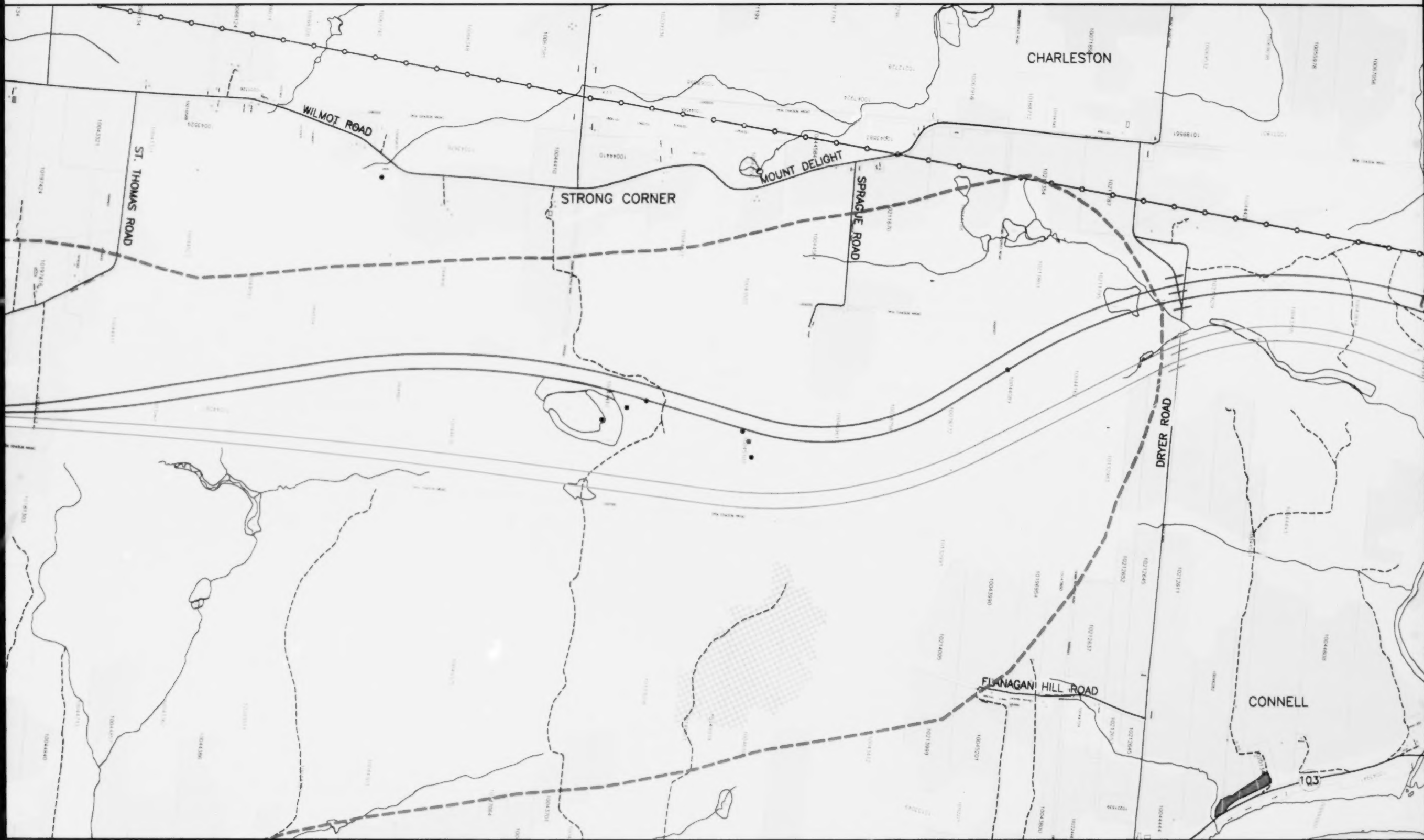


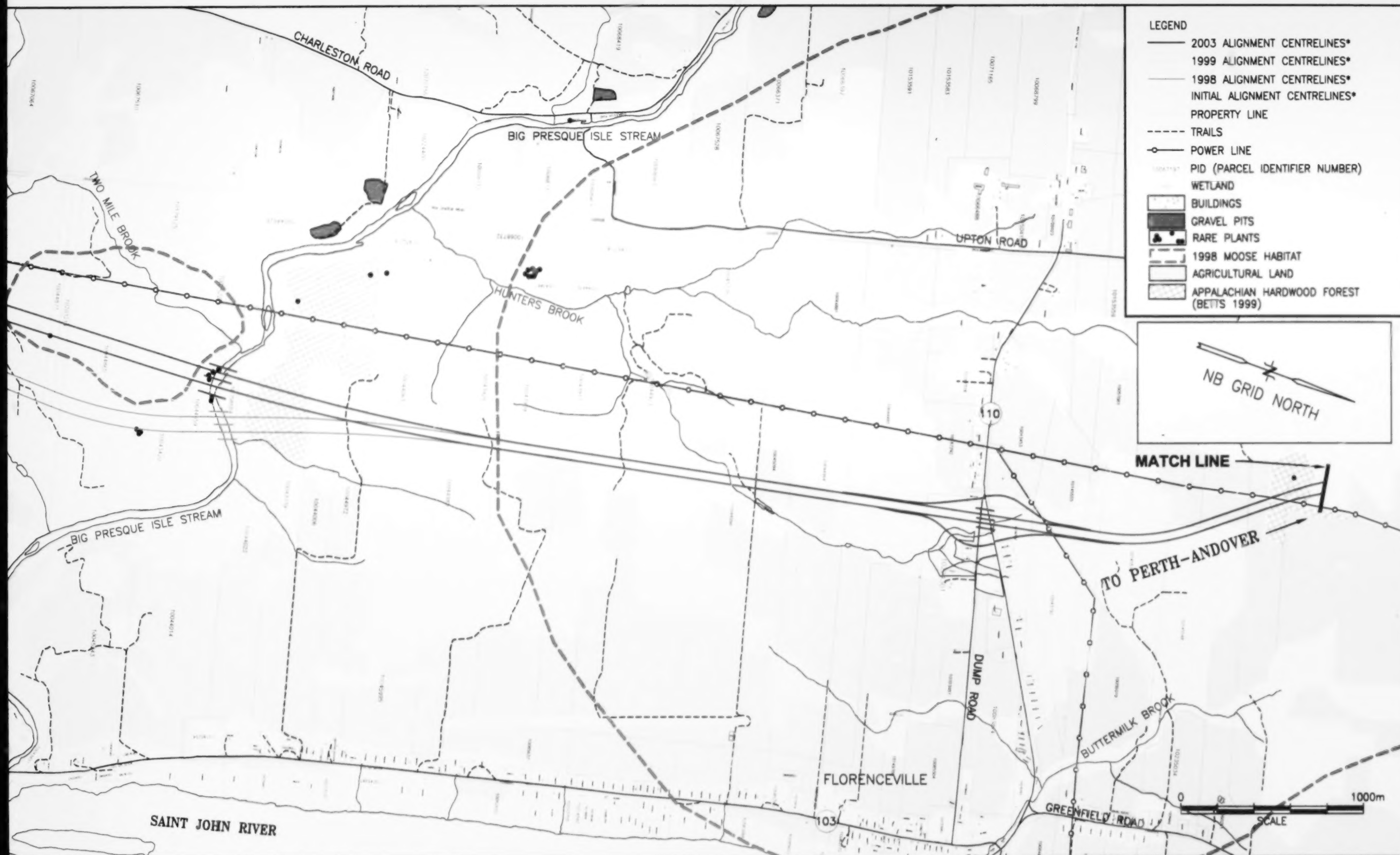
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Consulting Engineers
Environmental Scientists

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**ALTERNATIVE ALIGNMENTS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

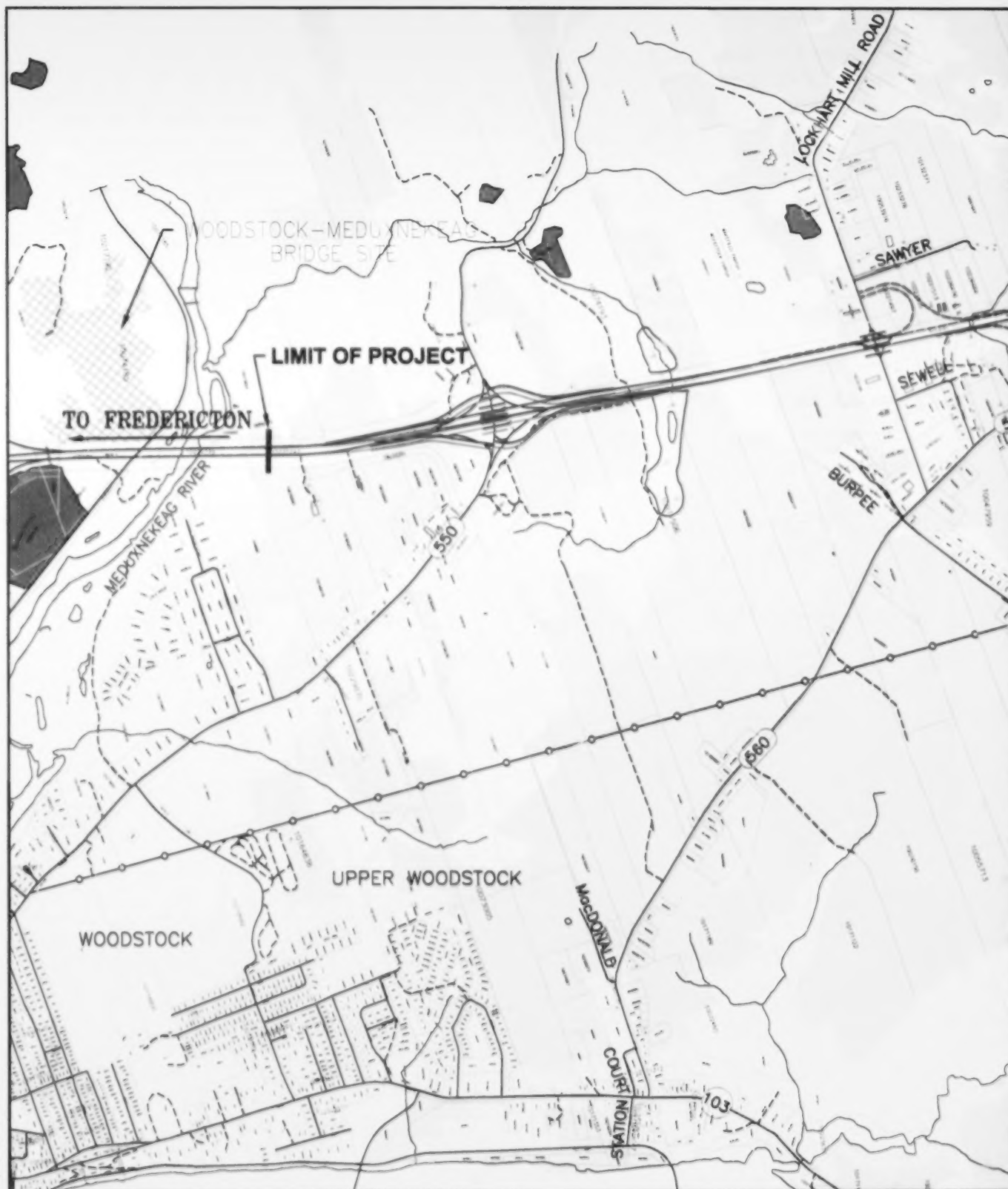
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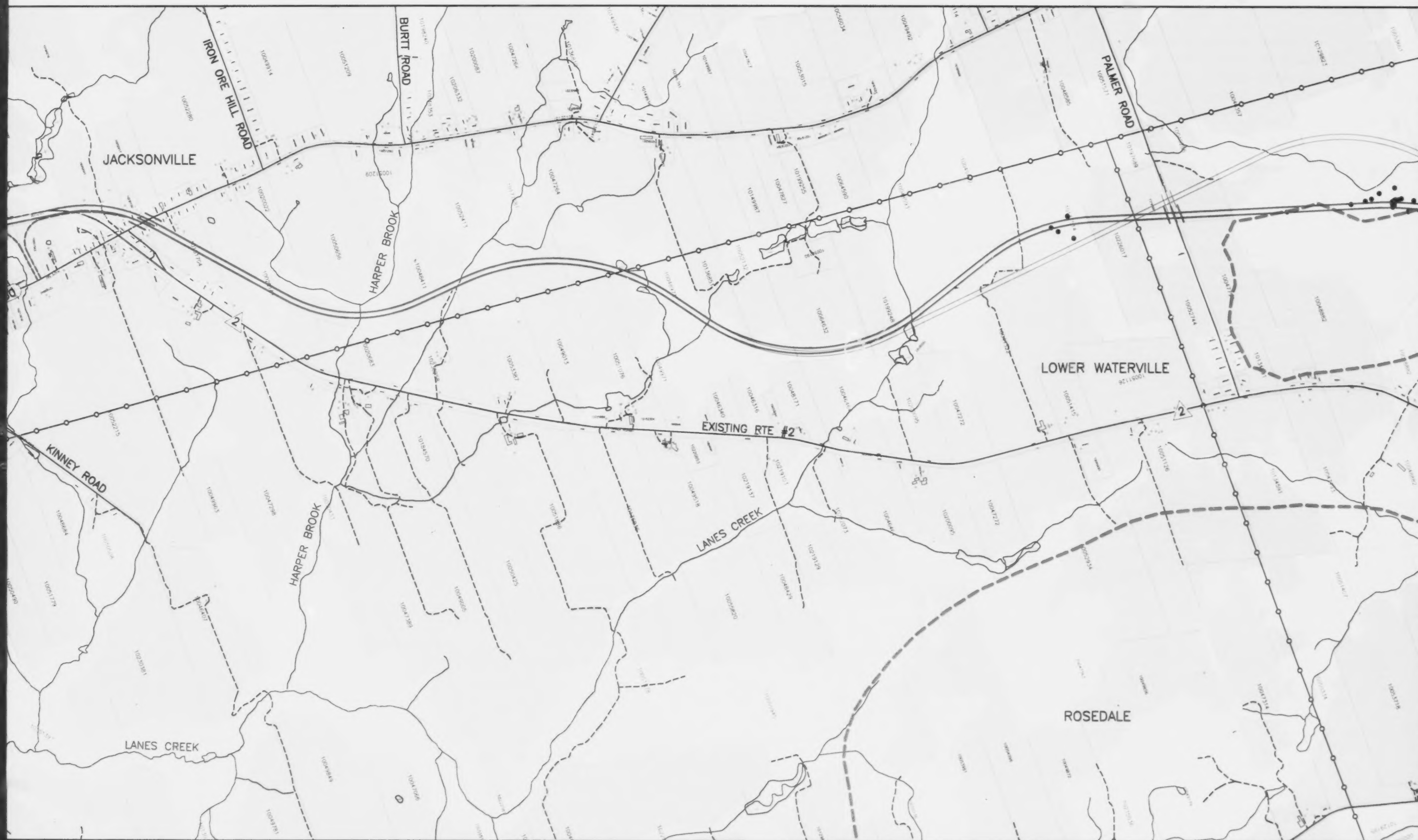


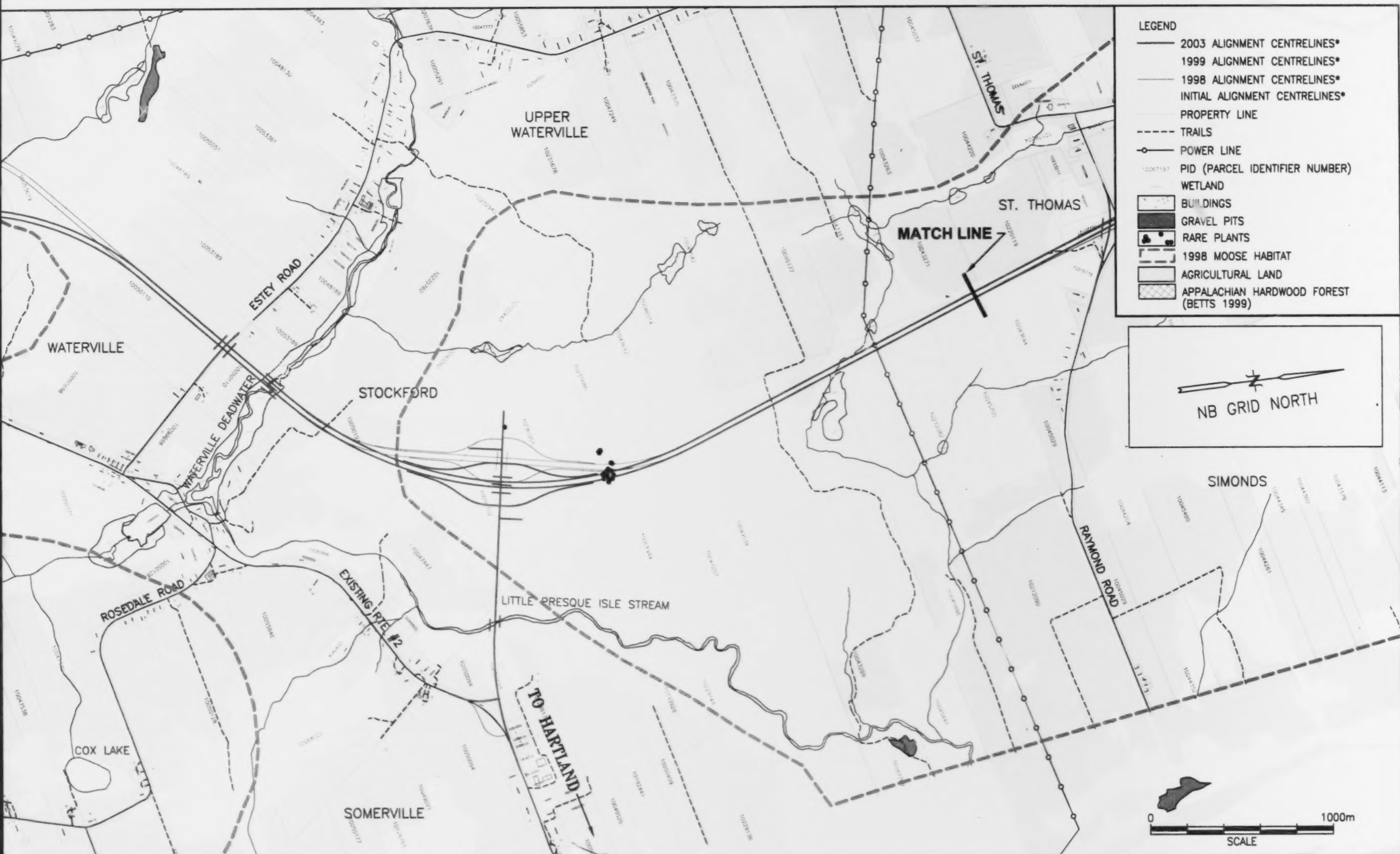
Jacques Whitford
Consulting Engineers
Environmental Scientists

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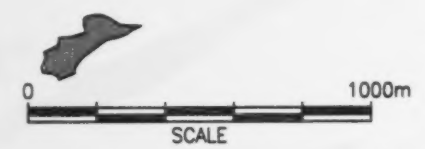




LEGEND

- 2003 ALIGNMENT CENTRELINES*
- 1999 ALIGNMENT CENTRELINES*
- 1998 ALIGNMENT CENTRELINES*
- INITIAL ALIGNMENT CENTRELINES*
- - - PROPERTY LINE
- - - TRAILS
- POWER LINE
- 10067197 PID (PARCEL IDENTIFIER NUMBER)
- WETLAND
- BUILDINGS
- GRAVEL PITS
- RARE PLANTS
- 1998 MOOSE HABITAT
- AGRICULTURAL LAND
- APPALACHIAN HARDWOOD FOREST (BETTS 1999)

NB GRID NORTH



ALTERNATIVE ALIGNMENTS NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT PERTH-ANDOVER TO WOODSTOCK		Date:	2004 02 03	Scale:	1 : 20 000	 Jacques Whitford Consulting Engineers Environmental Scientists
		Job No.:	14677	Fig. No.:	2.1-D	

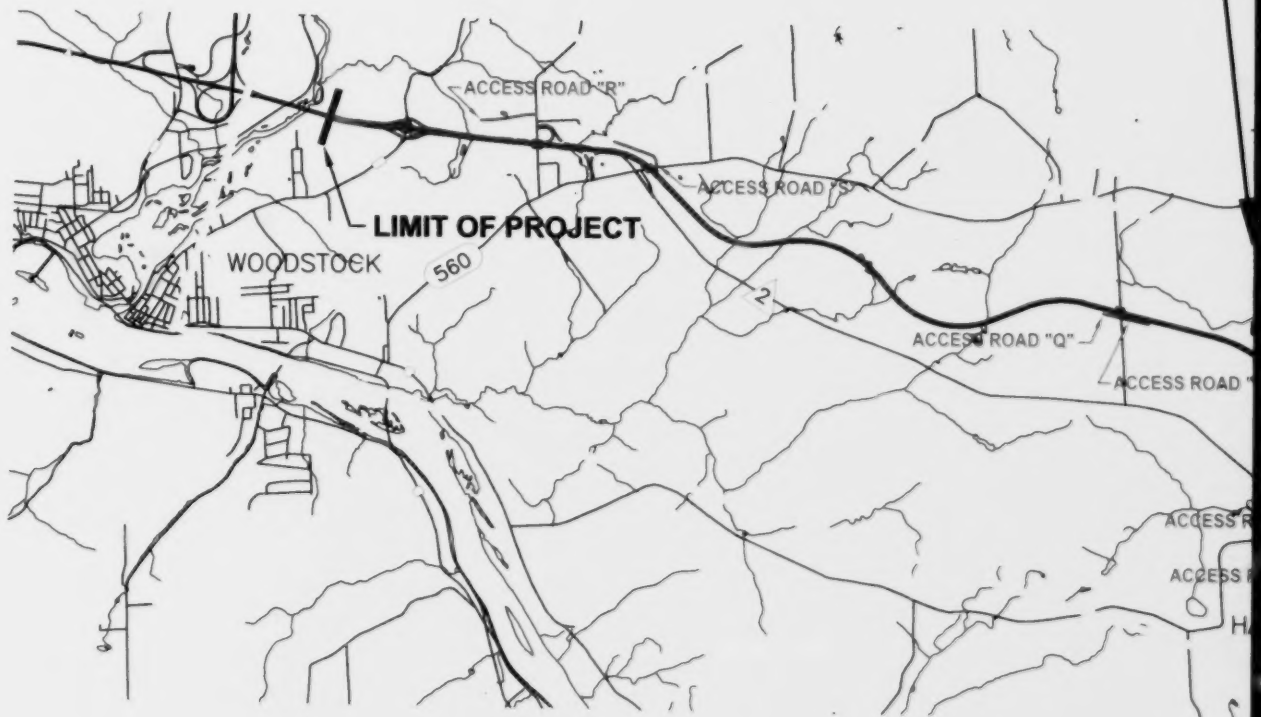
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APPENDIX C
PROJECT DESCRIPTION



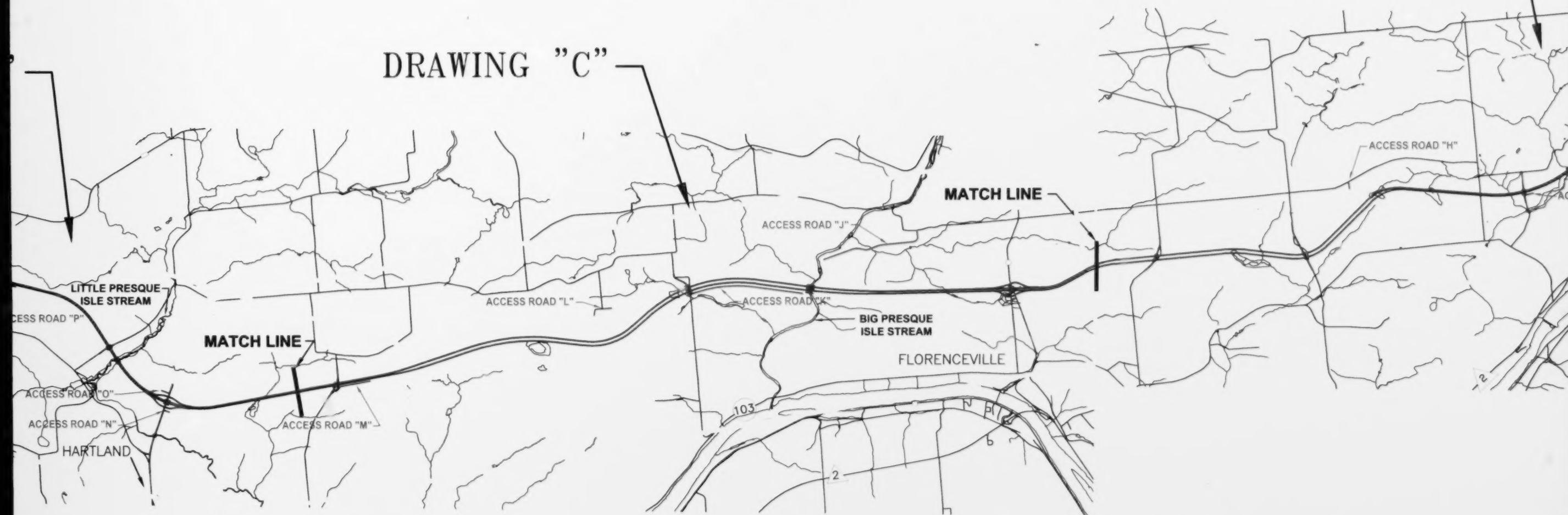


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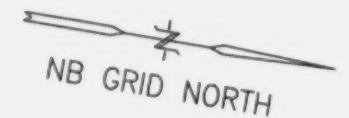
DRAWING "B"

DRAWING "C"

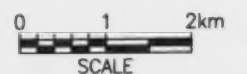
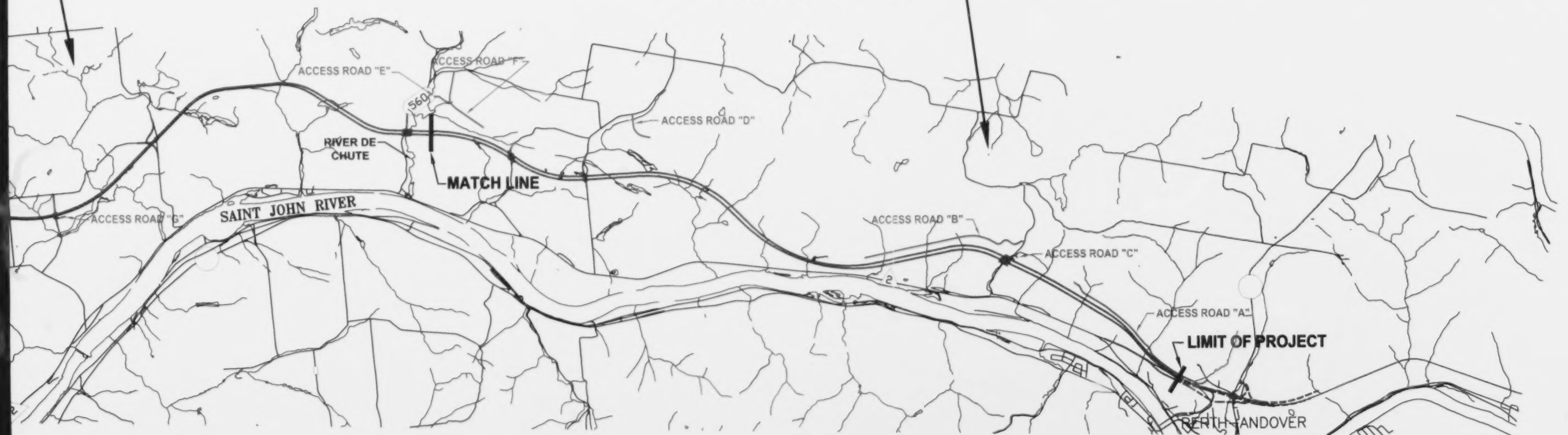


LEGEND

- 2003 ALIGNMENT CENTRELINE
- PROPERTY ACCESS ROADS



DRAWING "A"



PROPOSED ALIGNMENT NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT PERTH-ANDOVER TO WOODSTOCK

Date:
2004 02 04

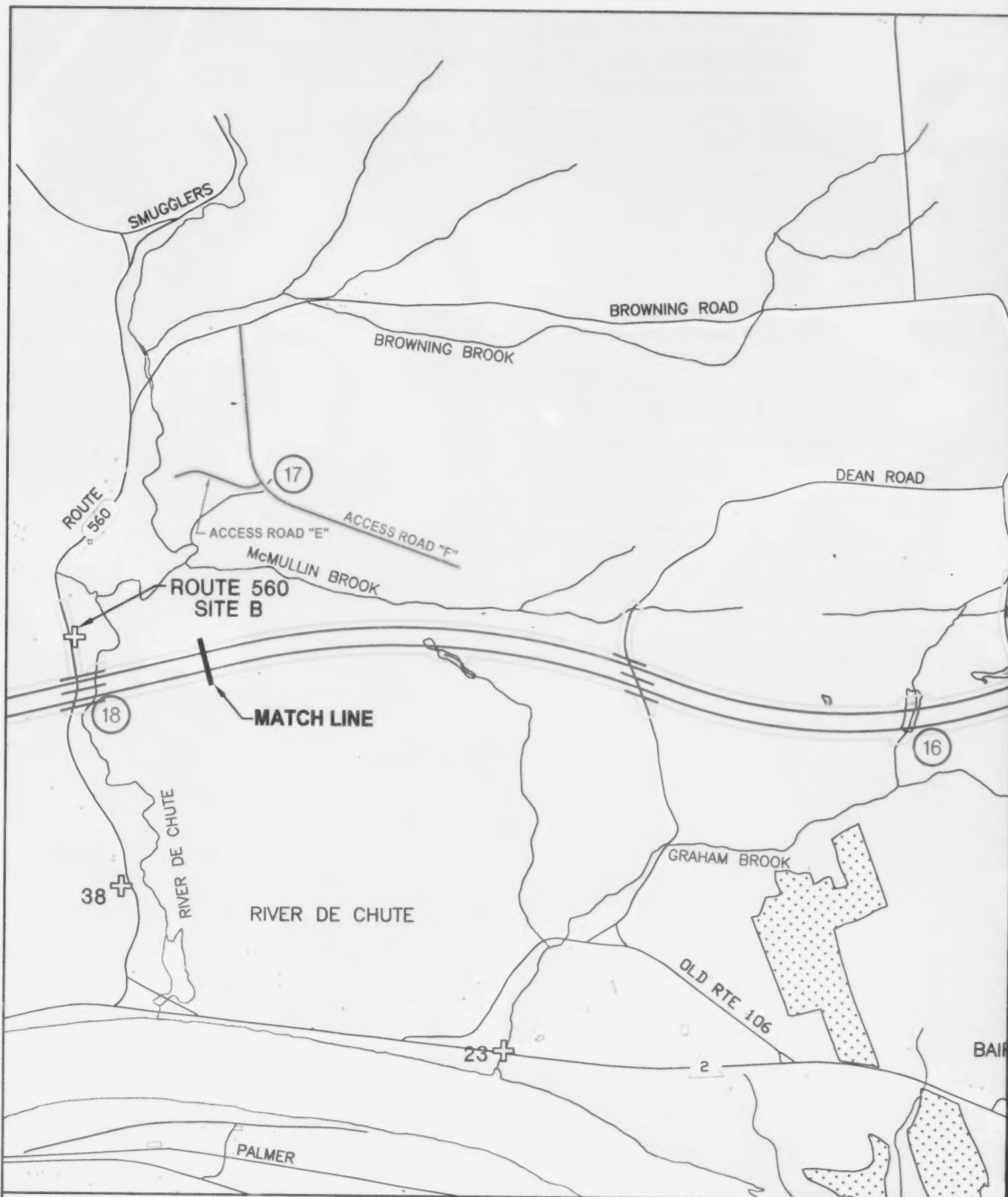
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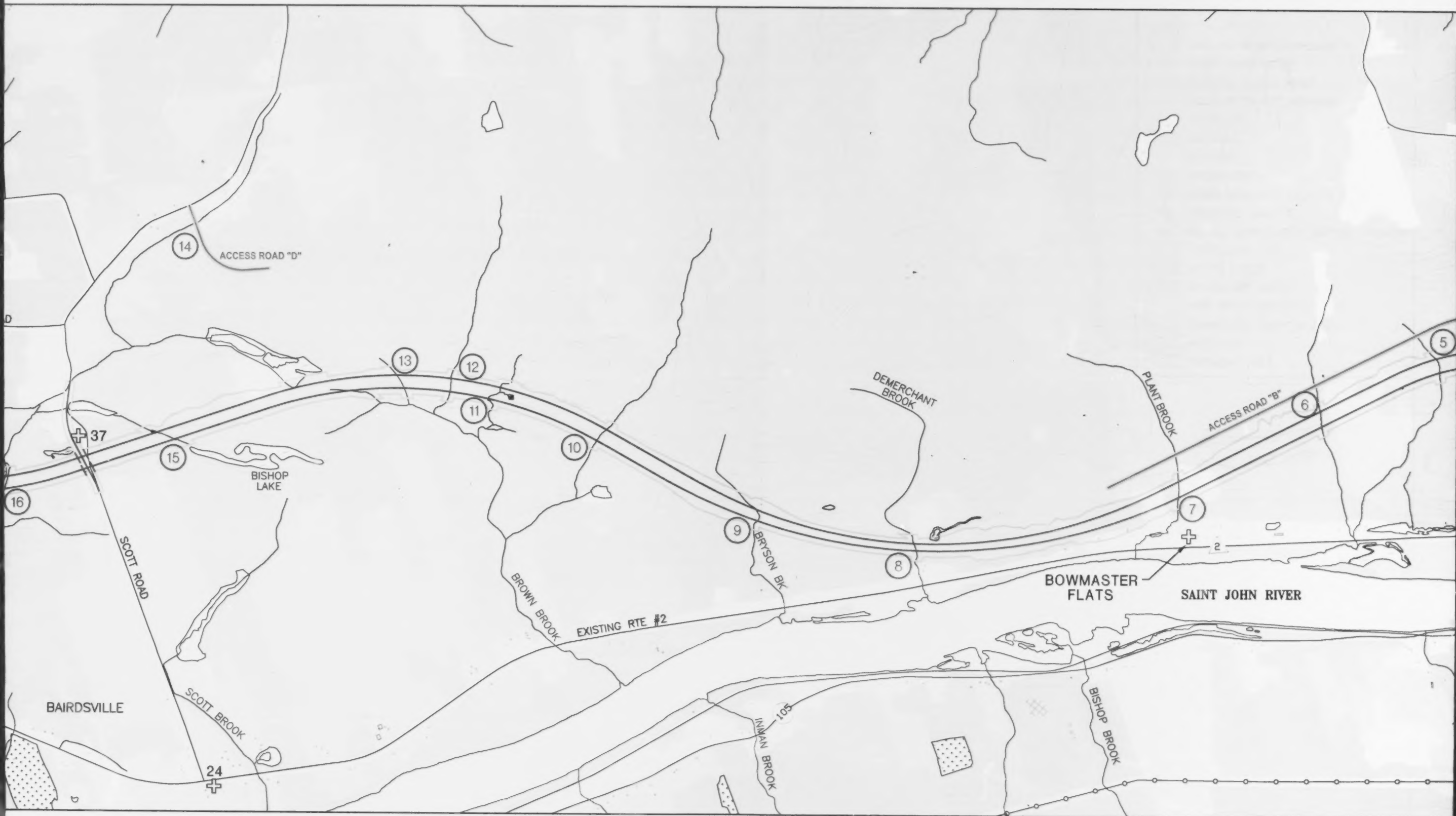
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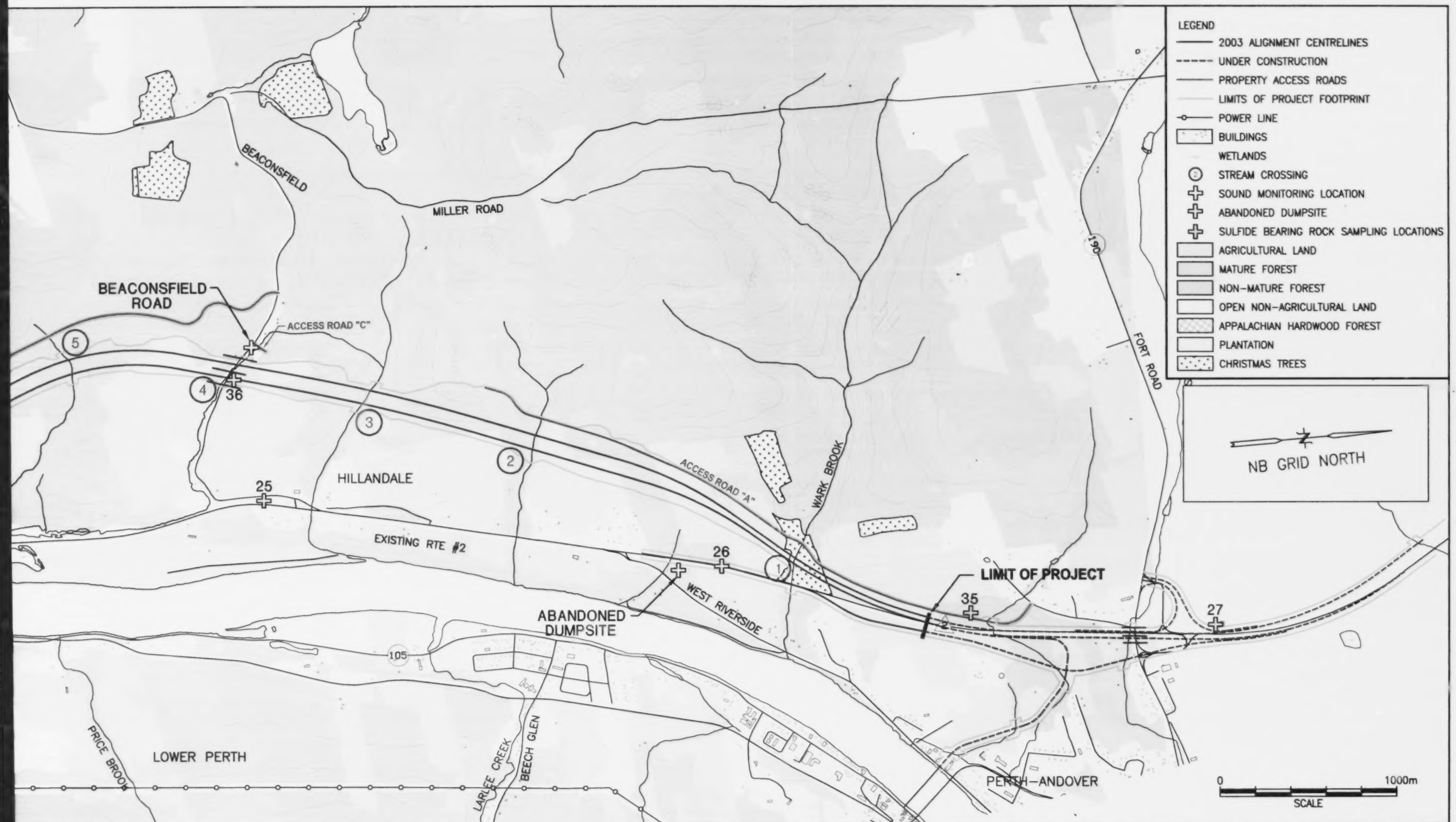
JW **Jacques Whitford**
Consulting Engineers
Environmental Scientists

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NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)





**PROPOSED ALIGNMENT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03
Job No.: 14677

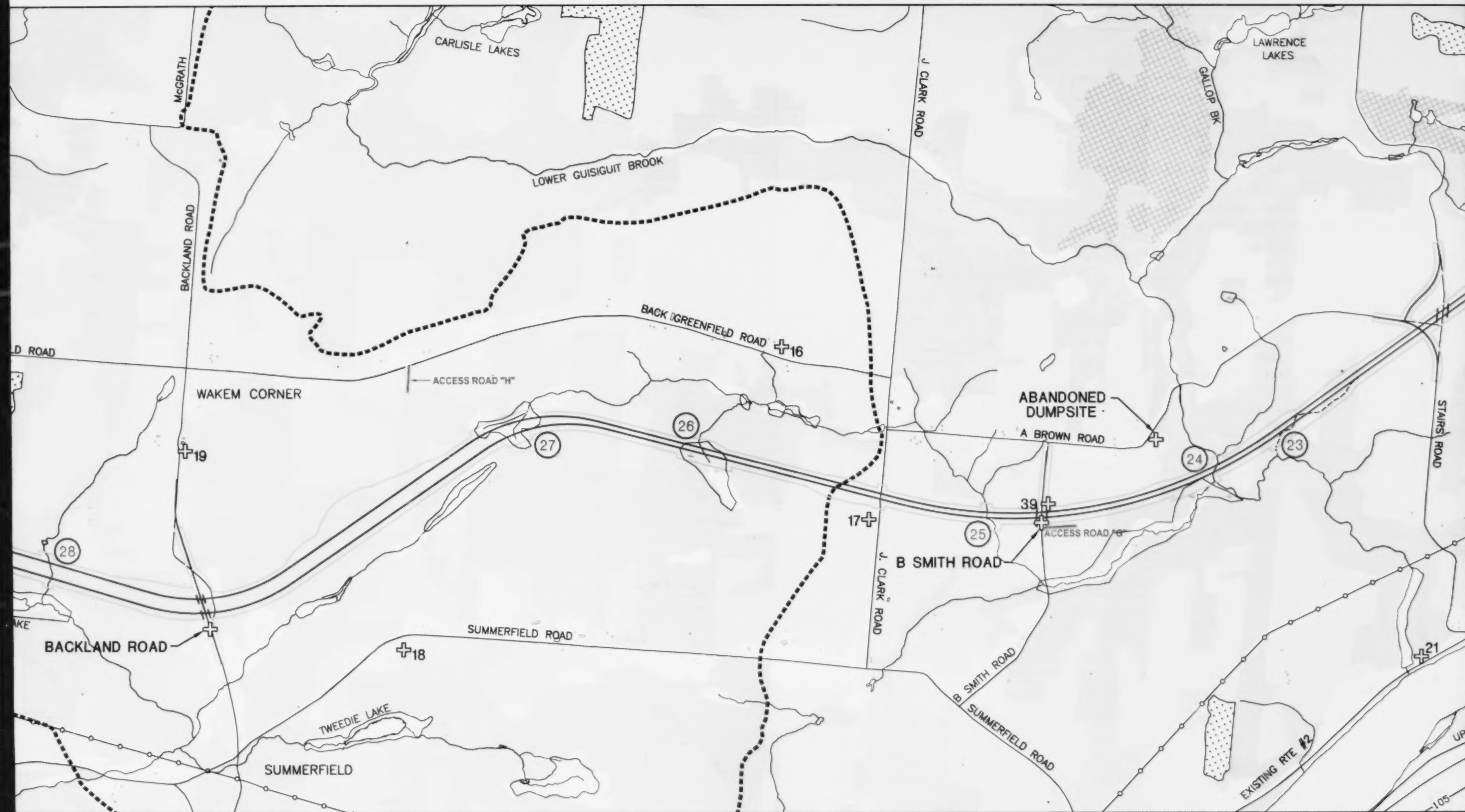
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Fig. No.: 3.2-A

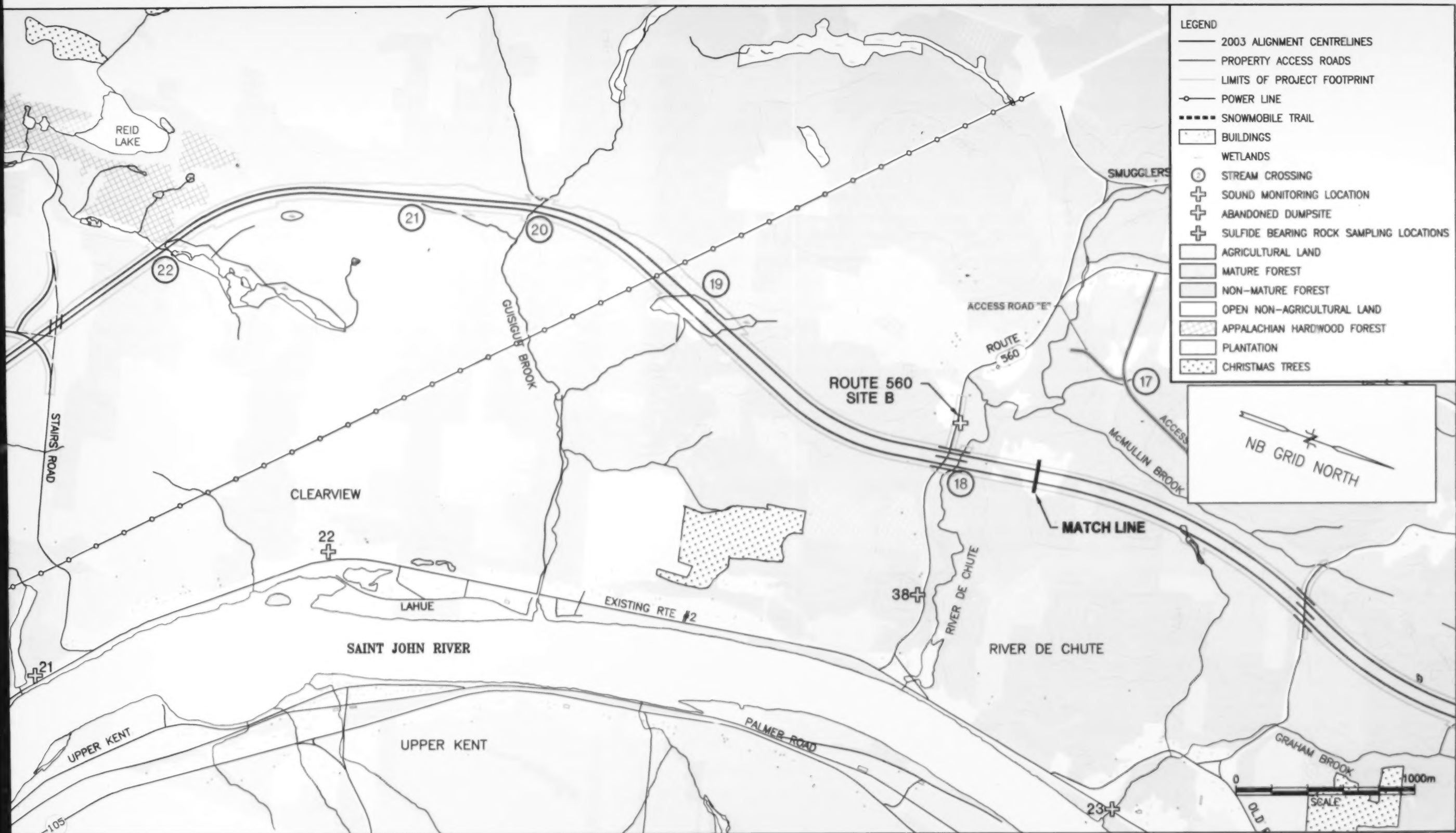
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Environmental Scientists

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NOTE:
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- LEGEND**
- 2003 ALIGNMENT CENTRELINES
 - PROPERTY ACCESS ROADS
 - LIMITS OF PROJECT FOOTPRINT
 - POWER LINE
 - SNOWMOBILE TRAIL
 - BUILDINGS
 - WETLANDS
 - STREAM CROSSING
 - ⊕ SOUND MONITORING LOCATION
 - ⊕ ABANDONED DUMPSITE
 - ⊕ SULFIDE BEARING ROCK SAMPLING LOCATIONS
 - AGRICULTURAL LAND
 - MATURE FOREST
 - NON-MATURE FOREST
 - OPEN NON-AGRICULTURAL LAND
 - APPALACHIAN HARDWOOD FOREST
 - PLANTATION
 - CHRISTMAS TREES

NB GRID NORTH

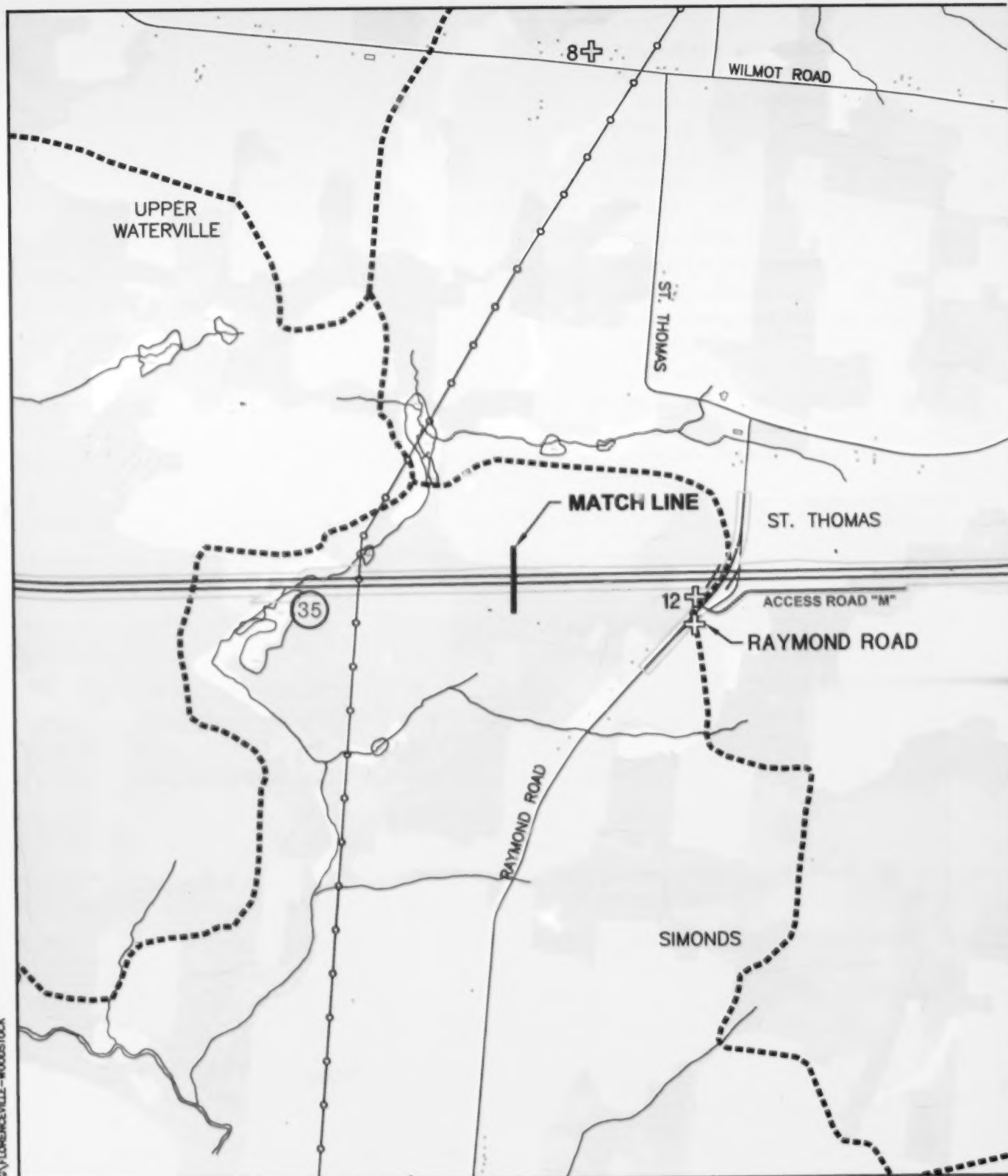
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**PROPOSED ALIGNMENT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03
Job No.: 14677

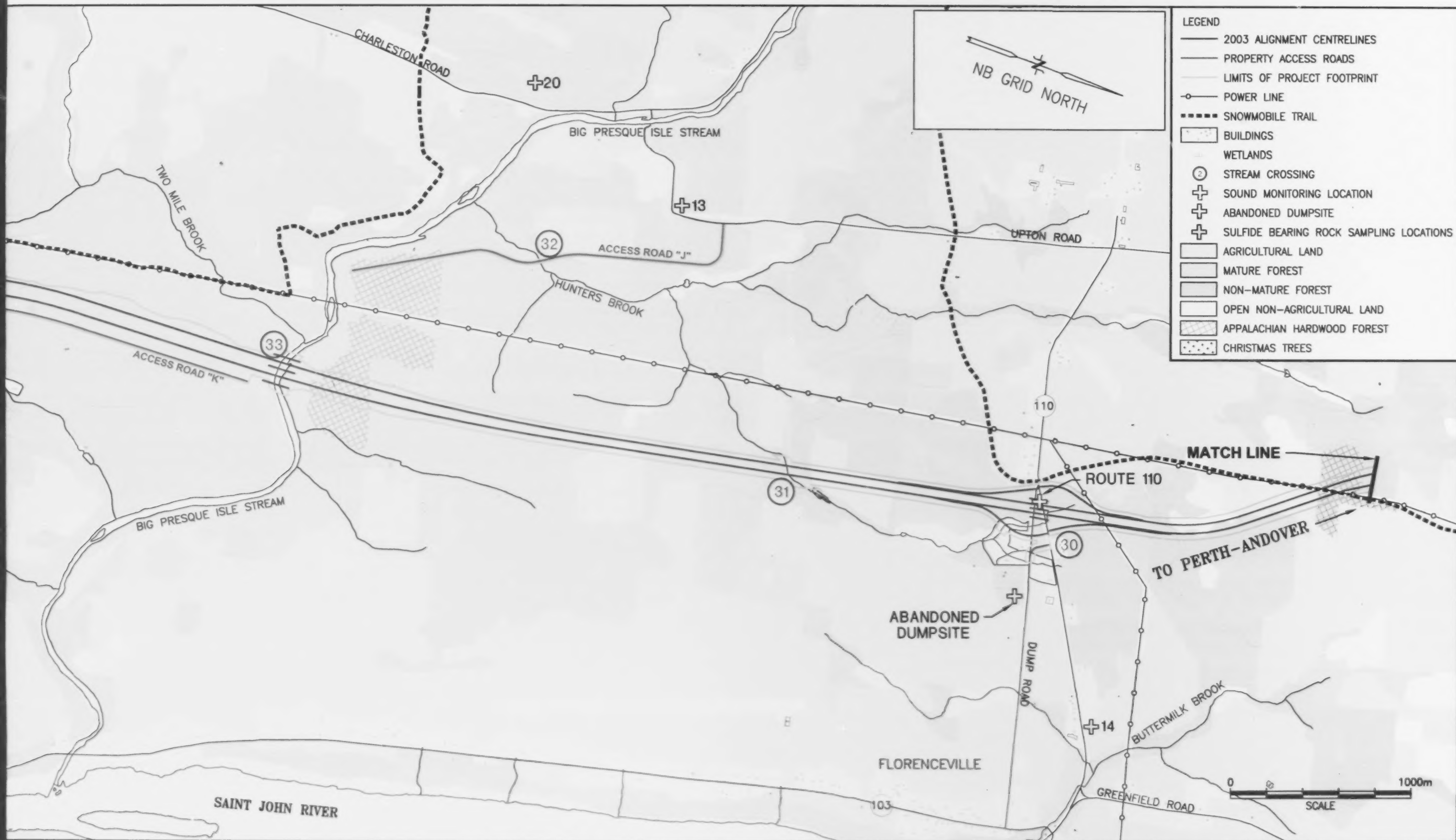
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Fig. No.: 3.2-B

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NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)





- LEGEND**
- 2003 ALIGNMENT CENTRELINES
 - PROPERTY ACCESS ROADS
 - LIMITS OF PROJECT FOOTPRINT
 - POWER LINE
 - SNOWMOBILE TRAIL
 - BUILDINGS
 - WETLANDS
 - ② STREAM CROSSING
 - + SOUND MONITORING LOCATION
 - + ABANDONED DUMPSITE
 - + SULFIDE BEARING ROCK SAMPLING LOCATIONS
 - AGRICULTURAL LAND
 - MATURE FOREST
 - NON-MATURE FOREST
 - OPEN NON-AGRICULTURAL LAND
 - APPALACHIAN HARDWOOD FOREST
 - CHRISTMAS TREES

**PROPOSED ALIGNMENT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date:
2004 02 03

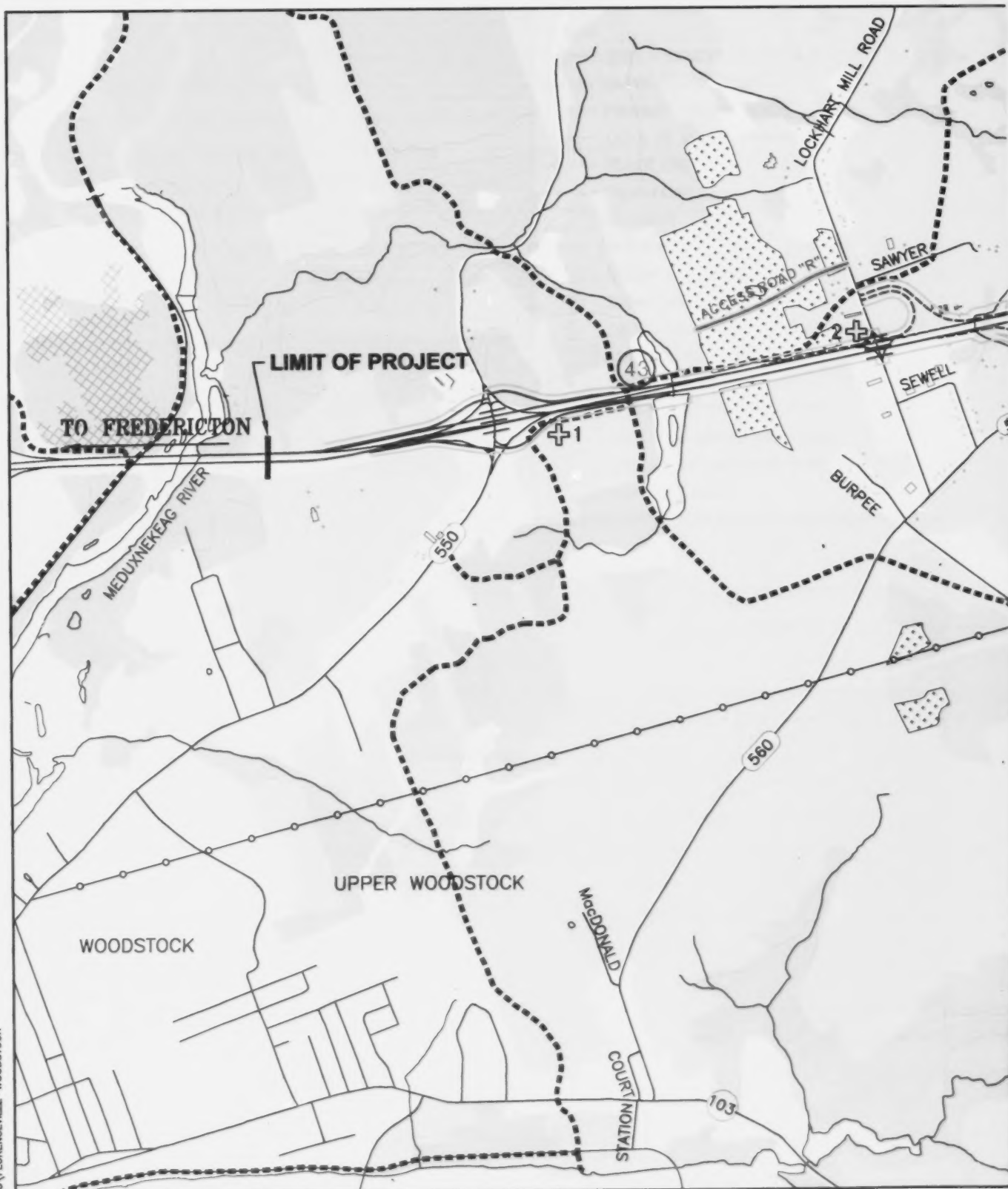
Job No.:
14677

Scale:
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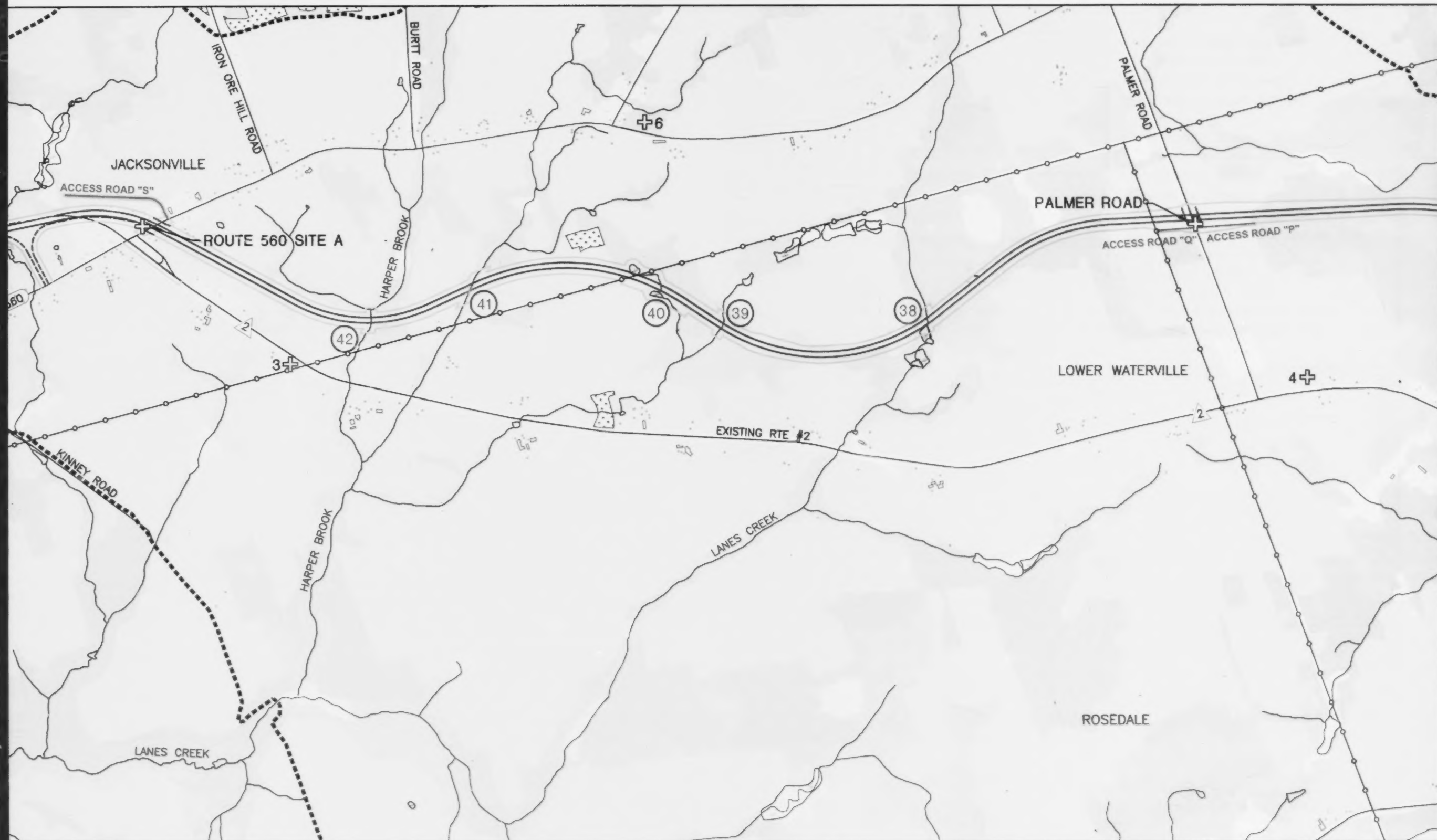
Fig. No.:
3.2-C

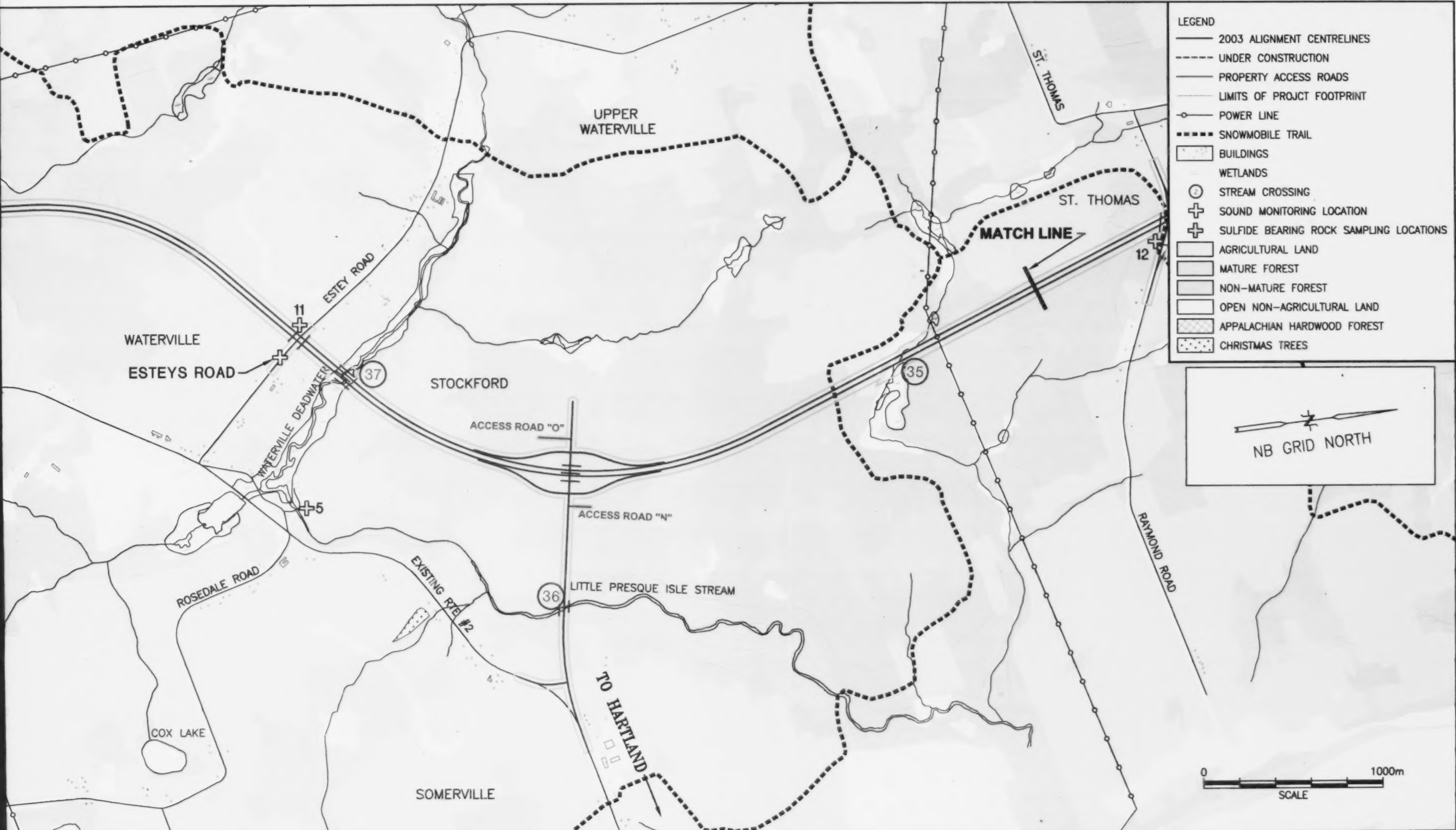
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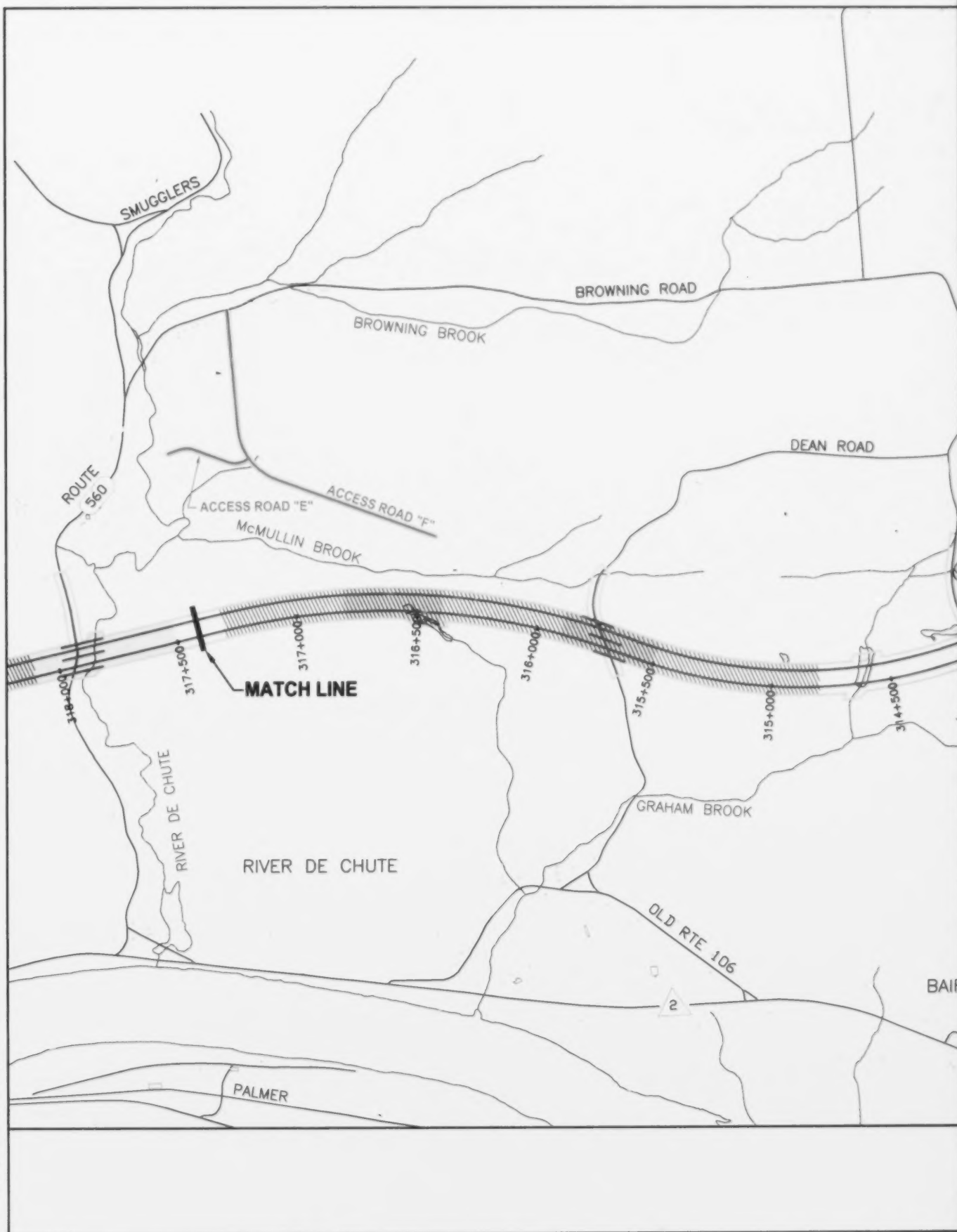




**PROPOSED ALIGNMENT
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date:	2004 02 03	Scale:	1 : 20 000
Job No.:	14677	Fig. No.:	3.2-D
 Jacques Whitford Consulting Engineers Environmental Scientists			

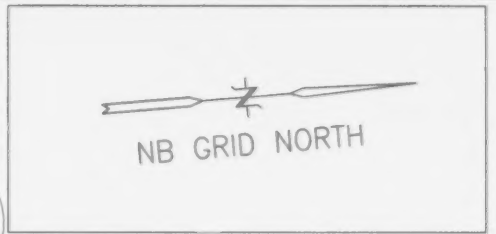
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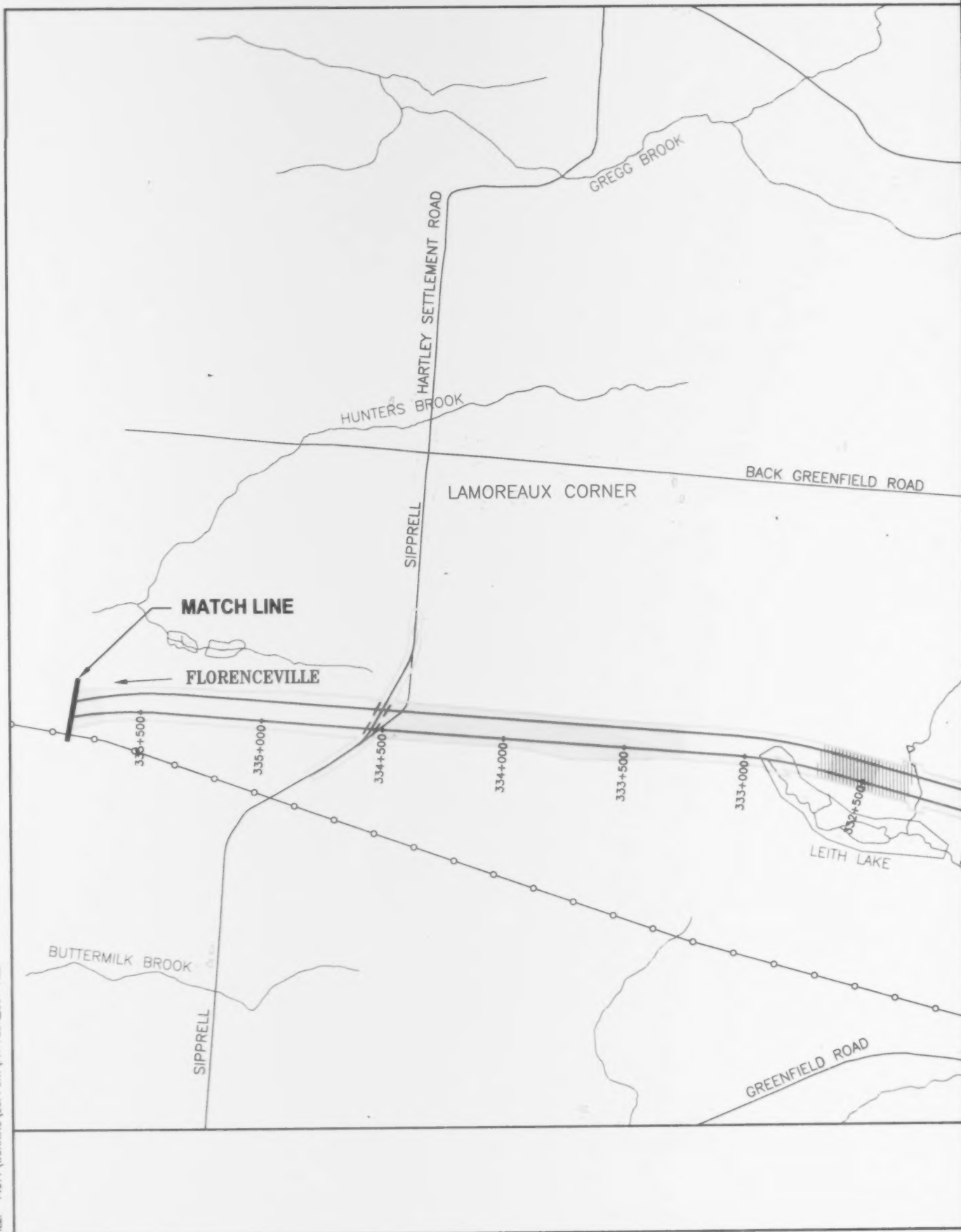
- LEGEND**
- 2003 ALIGNMENT CENTRELINES
 - - - UNDER CONSTRUCTION
 - PROPERTY ACCESS ROADS
 - LIMITS OF PROJECT FOOTPRINT
 - POWER LINE
 - BUILDINGS
 - WETLANDS
 - CUT
 - FILL
 - ▨ POTENTIAL SULFIDE BEARING ROCK



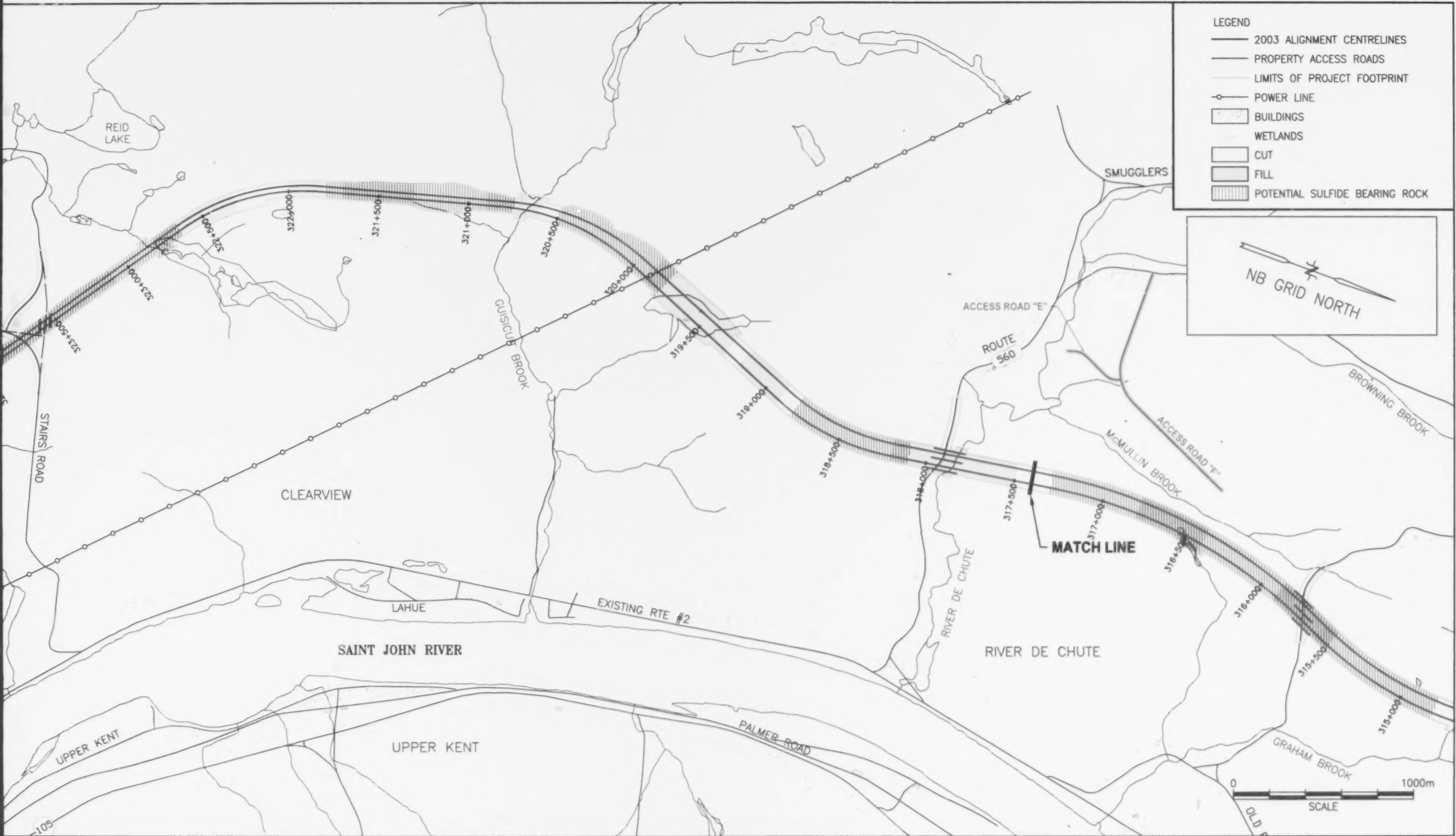
**CUT & FILL
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date:	2004 02 04	Scale:	1 : 20 000
Job No.:	14677	Fig. No.:	3.6-A

Jacques Whitford
Consulting Engineers
Environmental Scientists







- LEGEND
- 2003 ALIGNMENT CENTRELINES
 - PROPERTY ACCESS ROADS
 - LIMITS OF PROJECT FOOTPRINT
 - POWER LINE
 - ▢ BUILDINGS
 - ▨ WETLANDS
 - ▢ CUT
 - ▨ FILL
 - ▨ POTENTIAL SULFIDE BEARING ROCK

NB GRID NORTH

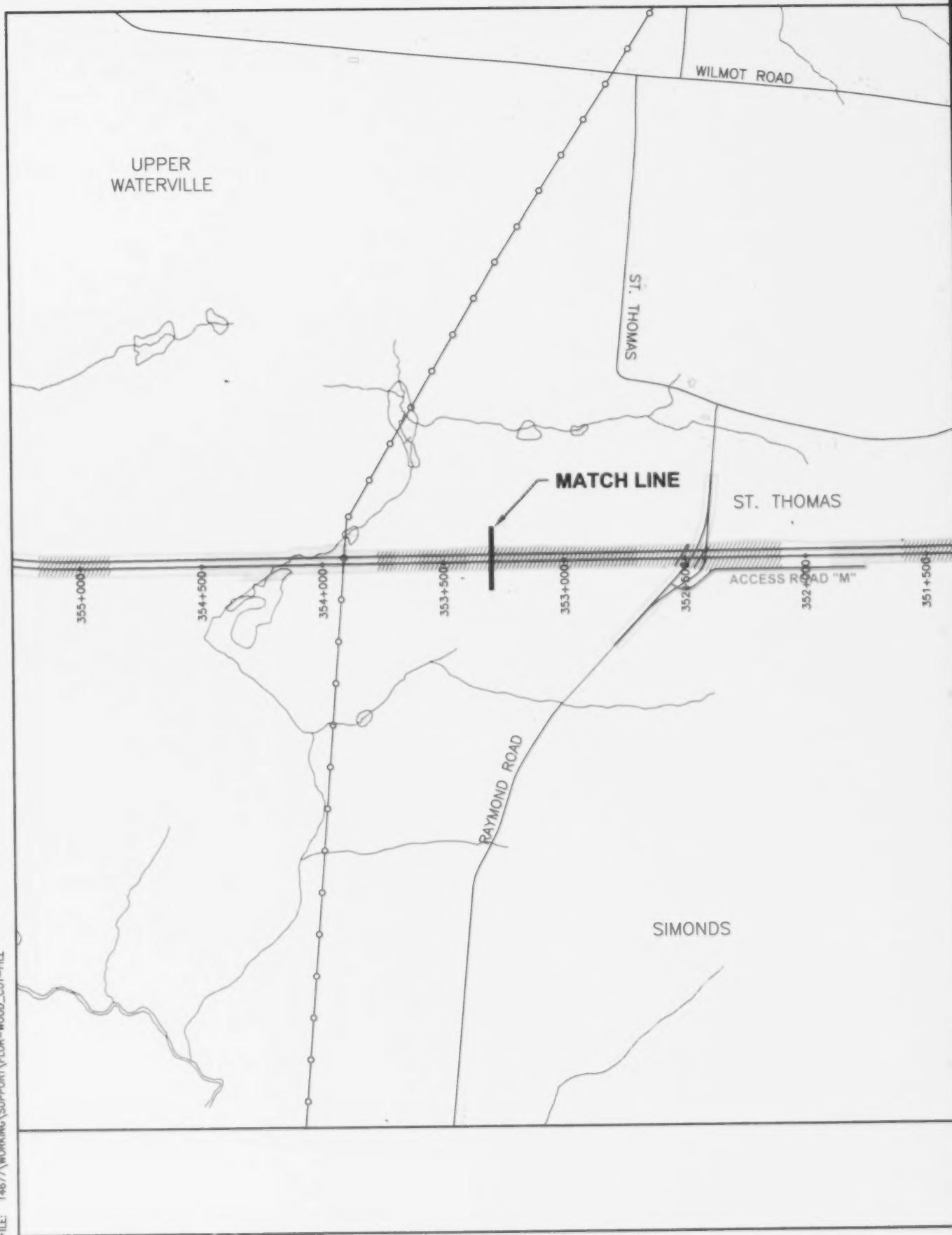
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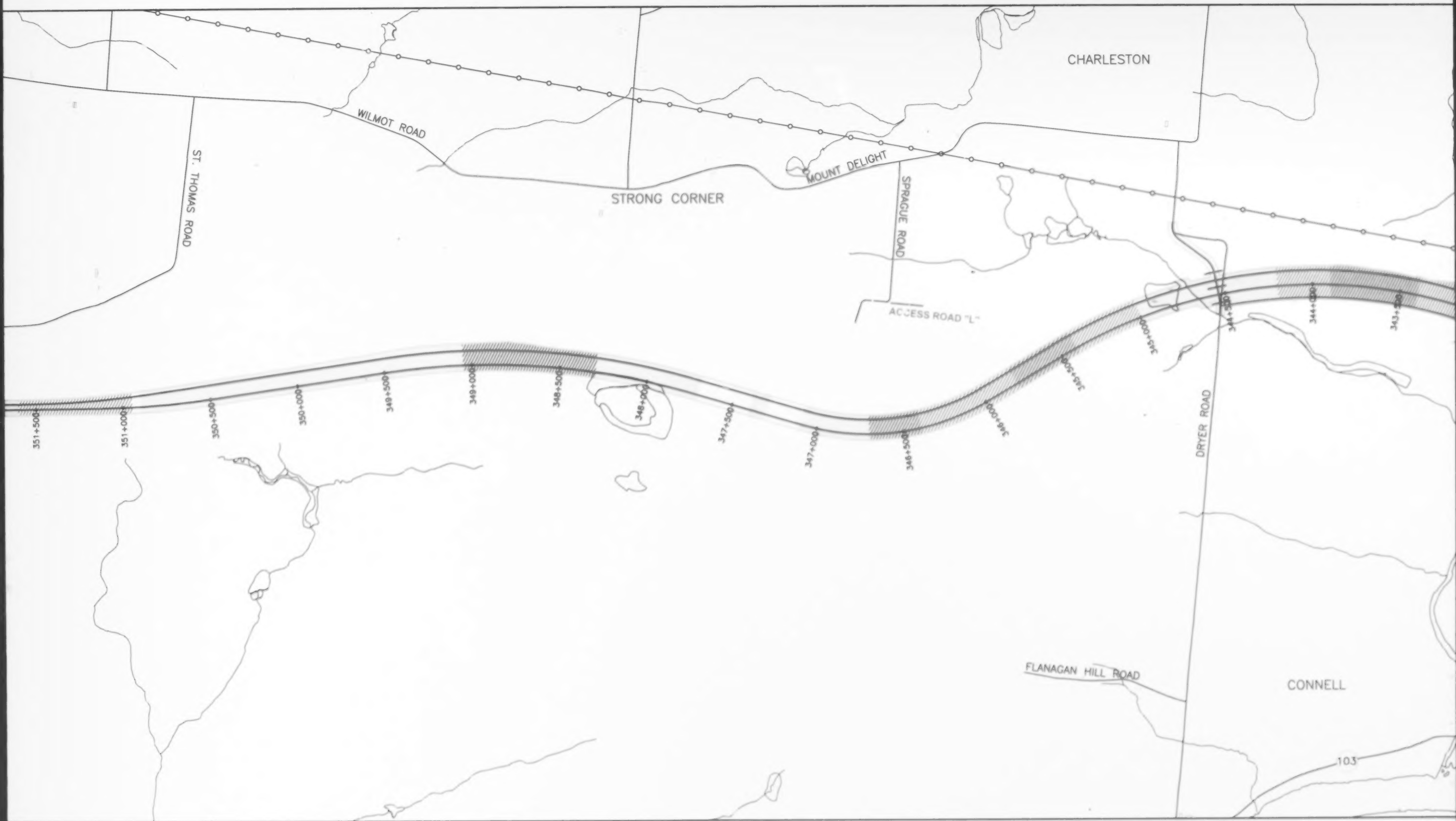
CUT & FILL
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date: 2004 02 04
 Job No.: 14677

Scale: 1 : 20 000
 Fig. No.: 3.6-B

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 Consulting Engineers
 Environmental Scientists







CUT & FILL
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

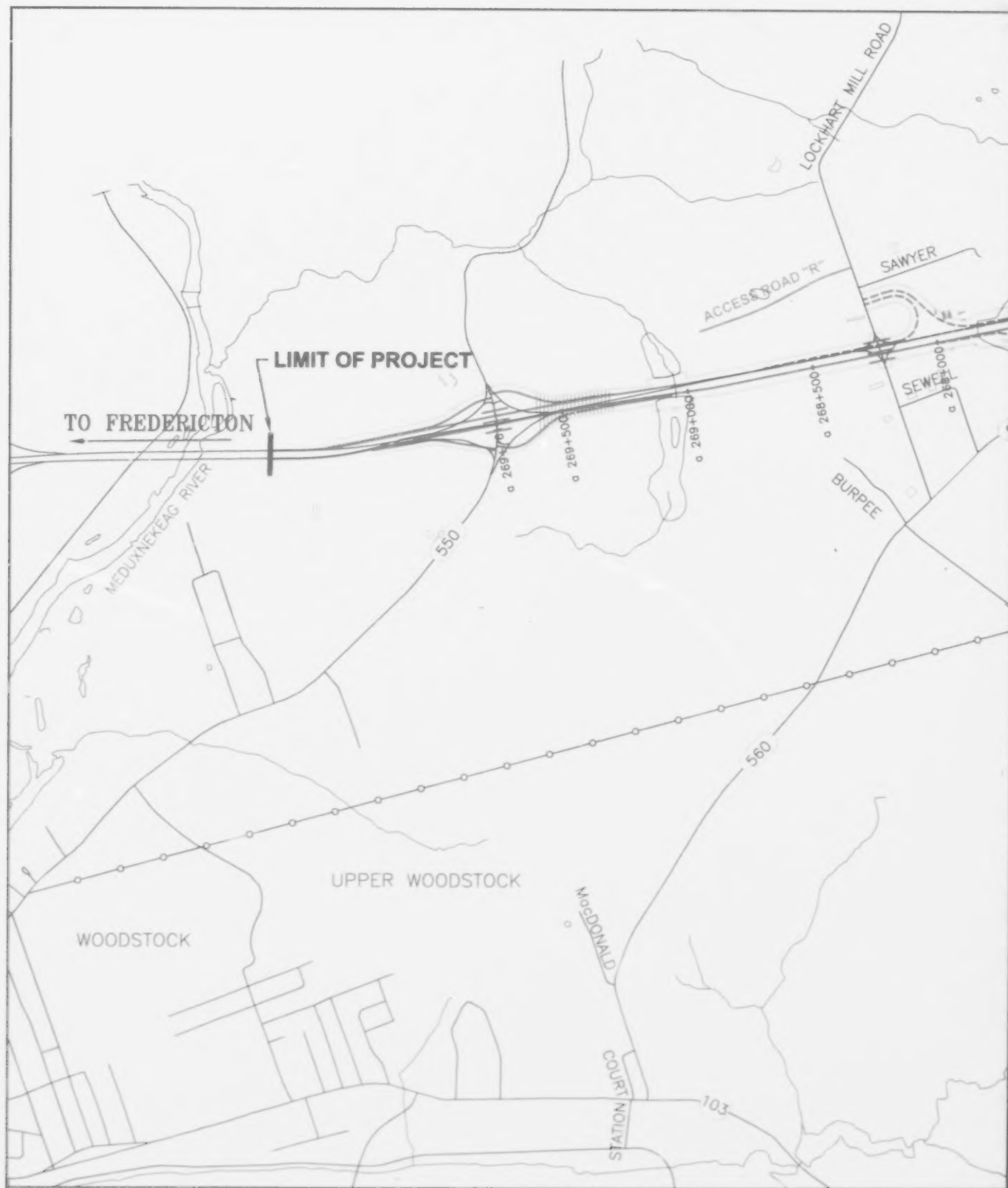
Date: 2004 02 04
 Job No.: 14677

Scale: 1 : 20 000
 Fig. No.: 3.6-C

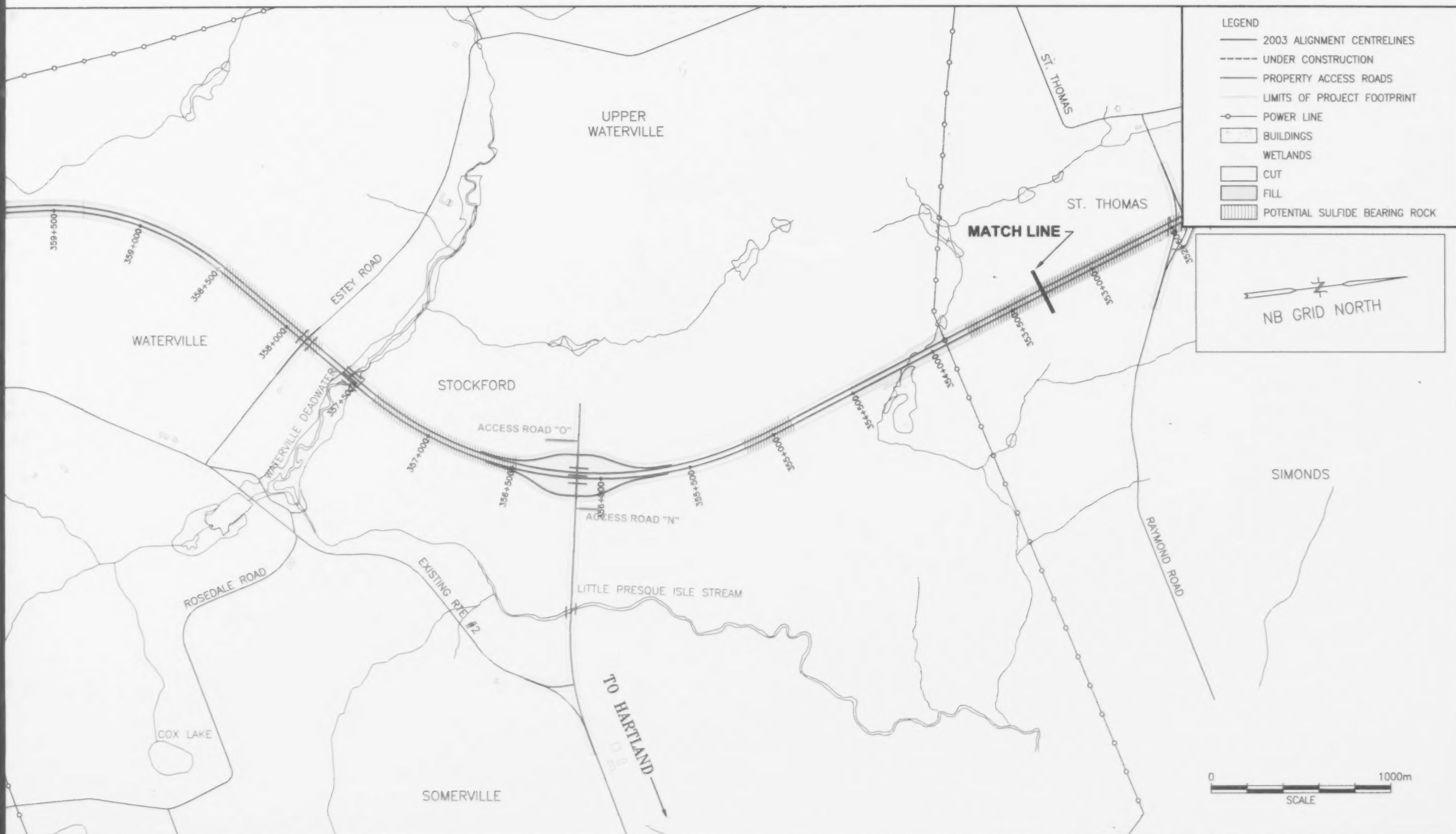


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CUT & FILL
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date: 2004 02 04

Job No.: 14677

Scale: 1 : 20 000

Fig. No.: 3.6-D



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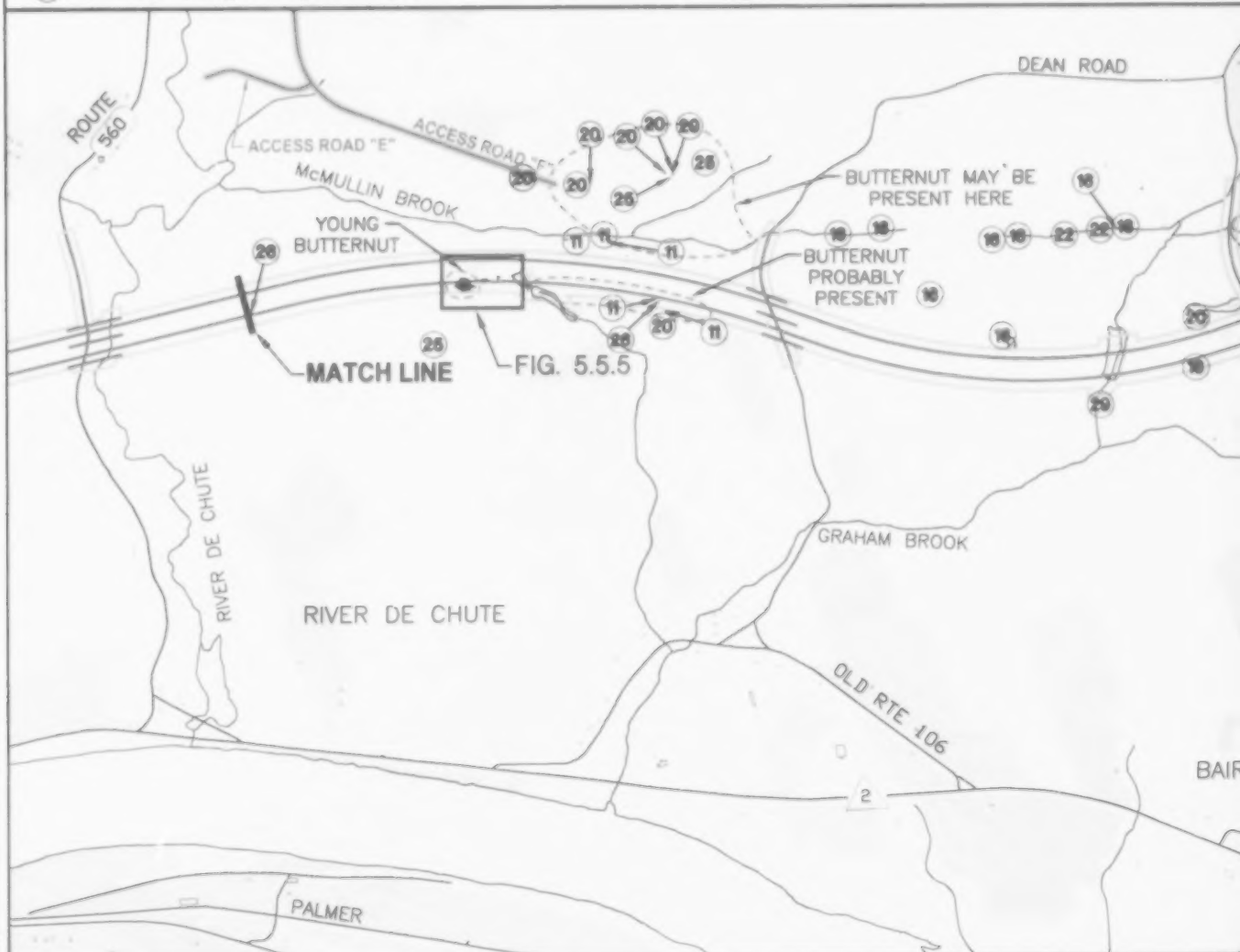
APPENDIX D
VEGETATION





RARE PLANT LEGEND

- | | |
|--|---|
| 1 BOTTLE-BRUSH GRASS (<i>Elymus hystrix</i>) | 16 CANADA CLEARWEED (<i>Pilea pumila</i>) |
| 2 NODDING FESCUE (<i>Festuca subverticillata</i>) | 17 LESSER BLADDERWORT (<i>Utricularia minor</i>) |
| 3 PALE TOUCH-ME-NOT (<i>Impatiens pallida</i>) | 18 NORTHERN MAIDENHAIR-FERN (<i>Adiantum pedatum</i>) |
| 4 FRAGRANT BLACK SNAKE-ROOT (<i>Sanicula odorata</i>) | 19 LANCE-LEAF GRAPEFERN (<i>Botrychium lanceolatum</i>) |
| 5 LEATHERWOOD (<i>Dirca palustris</i>) | 20 LARGE YELLOW LADY'S-SLIPPER (<i>Cypripedium pubescens</i>) |
| 6 CANADA VIOLET (<i>Viola canadensis</i>) | 21 BRAUN'S HOLLY FERN (<i>Polystichum braunii</i>) |
| 7 CALYPSO 'OR VENUS' SLIPPER (<i>Calypso bulbosa</i>) | 22 SMALL YELLOW WATER-CROWFOOT (<i>Ranunculus abortivus</i>) |
| 8 MOUNTAIN VALERIAN (<i>Valeriana uliginosa</i>) | 23 CLAMMY-HEDGE-HYSSOP (<i>Cratiola neglecta</i>) |
| 9 HOOKED AGRIMONY (<i>Agrimonia gryposepala</i>) | 24 SMALL-FRUITED BURREED (<i>Sparganium angustifolium</i>) |
| 10 BOREAL BOG SEDGE (<i>Carex magellanica</i> ssp. <i>magellanica</i>) | 25 BLUE COHOSH (<i>Caulophyllum thalictroides</i>) |
| 11 PLANTAIN-LEAVED SEDGE (<i>Carex plantaginea</i>) | 26 ROSY SEDGE (<i>Carex rosea</i>) |
| 12 SPRENGEL'S SEDGE (<i>Carex sprengelii</i>) | 27 HEARTLEAF TWAYBLADE (<i>Listera cordata</i>) |
| 13 SHOWY LADY'S-SLIPPER (<i>Cypripedium reginae</i>) | 28 FEN GRASS-OF-PARNASSUS (<i>Parnassia glauca</i>) |
| 14 GOLDIE'S FERN (<i>Dryopteris goldiana</i>) | 29 BLACK-SEED PLANTAIN (<i>Plantago rugelii</i>) |
| 15 LOPSEED (<i>Phryma leptostachya</i>) | 30 HIDDEN-SCALED SEDGE (<i>Carex cryptolepis</i>) |
| | 31 LESSER TUSOCK SEDGE (<i>Carex diandra</i>) |

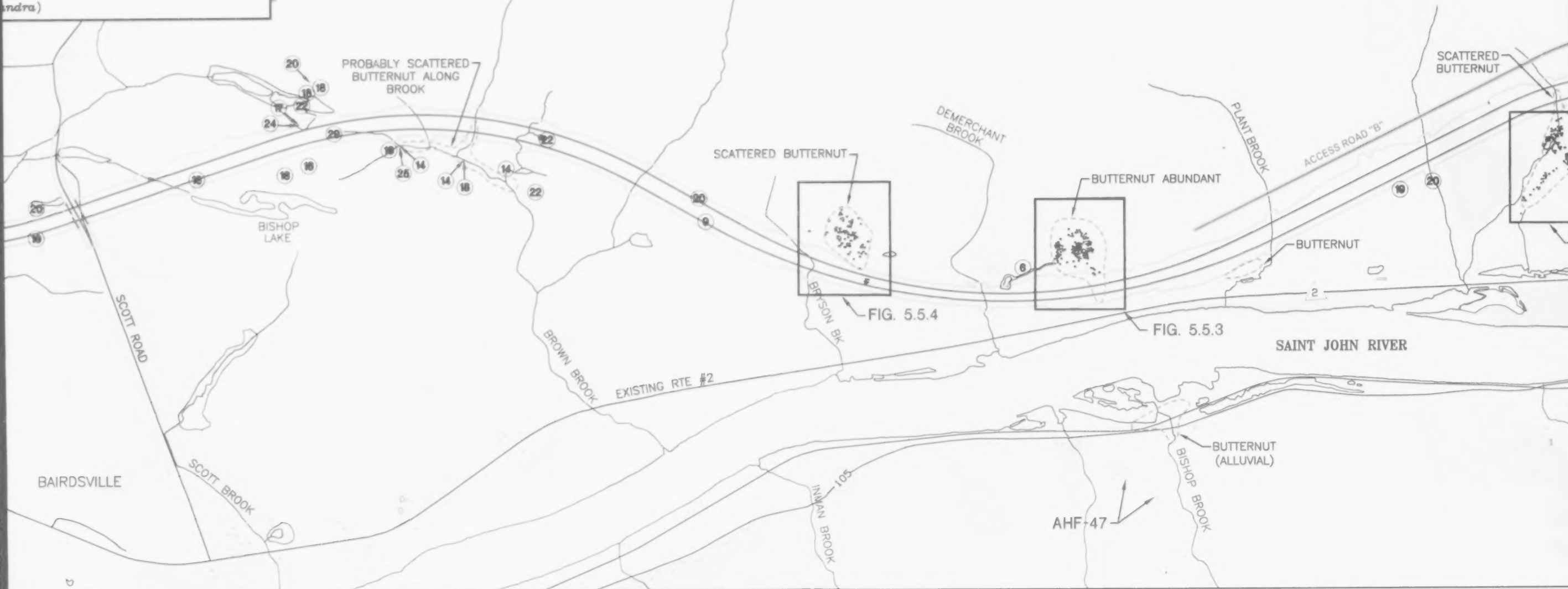


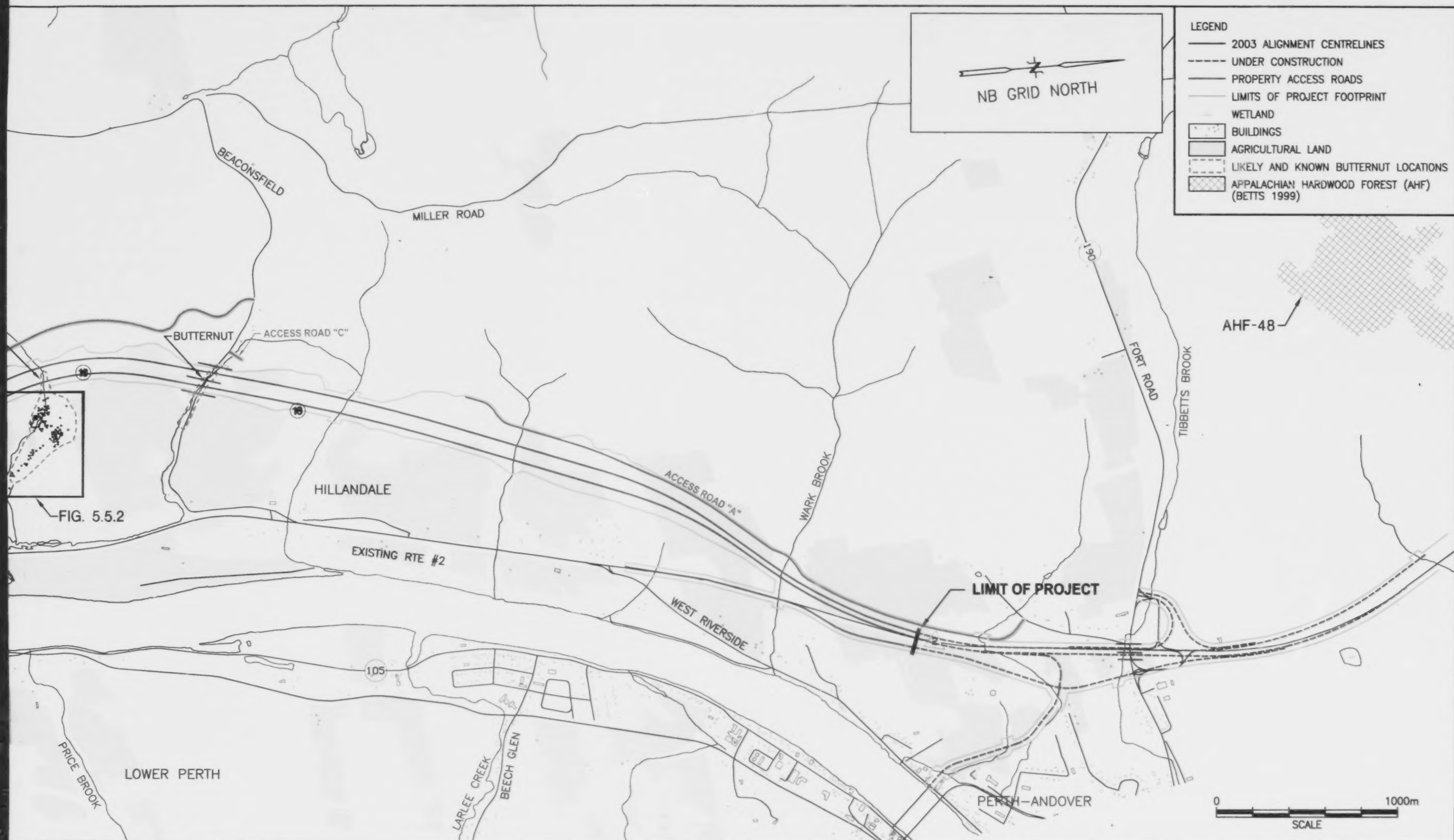
NOTE:

ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)

minor)
 ntum pedatum)
 m lanceolatum var. angustisegmentum)
 ripedium parviflorum var. pubescens)
 braunii)
 anunculus gmelinii var. purshii)
 neglecta)
 ium natans)
 ctroides)
 ata)
 esia glauca)
 ugellii)
 tolepis)
 andra)

ROAD "D"





LEGEND

- 2003 ALIGNMENT CENTRELINES
- - - UNDER CONSTRUCTION
- PROPERTY ACCESS ROADS
- LIMITS OF PROJECT FOOTPRINT
- WETLAND
- BUILDINGS
- AGRICULTURAL LAND
- LIKELY AND KNOWN BUTTERNUT LOCATIONS
- APPALACHIAN HARDWOOD FOREST (AHF) (BETTS 1999)

**RARE PLANTS AND APPALACHIAN HARDWOOD FOREST
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date:	2004 02 12	Scale:	1 : 20 000
Job No.:	14677	Fig. No.:	5.5.1-A

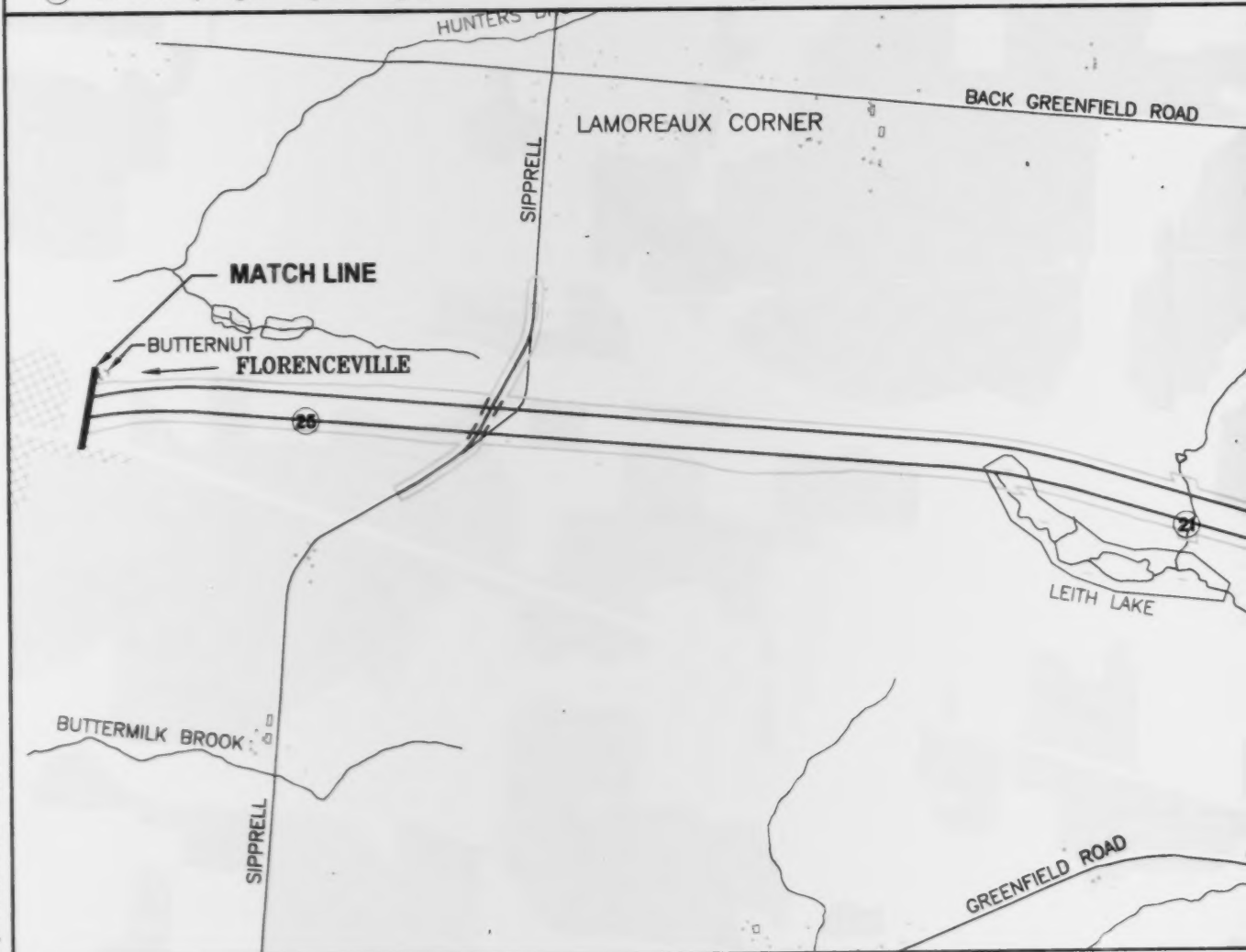
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Environmental Scientists

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RARE PLANT LEGEND

- 1 BOTTLE-BRUSH GRASS (*Elymus hystrix*)
- 2 NODDING FESCUE (*Festuca subverticillata*)
- 3 PALE TOUCH-ME-NOT (*Impatiens pallida*)
- 4 FRAGRANT BLACK SNAKE-ROOT (*Sanicula odorata*)
- 5 LEATHERWOOD (*Dirca palustris*)
- 6 CANADA VIOLET (*Viola canadensis*)
- 7 CALYPSO OR VENUS' SLIPPER (*Calypso bulbosa*)
- 8 MOUNTAIN VALERIAN (*Valeriana uliginosa*)
- 9 HOOKED AGRIMONY (*Agrimonia gryposepala*)
- 10 BOREAL BOG SEDGE (*Carex magellanica* ssp. *magellanica*)
- 11 PLANTAIN-LEAVED SEDGE (*Carex plantaginea*)
- 12 SPRENGEL'S SEDGE (*Carex sprengelii*)
- 13 SHOWY LADY'S-SLIPPER (*Cypripedium reginae*)
- 14 GOLDIE'S FERN (*Dryopteris goldiana*)
- 15 LOPSEED (*Phryma leptostachya*)

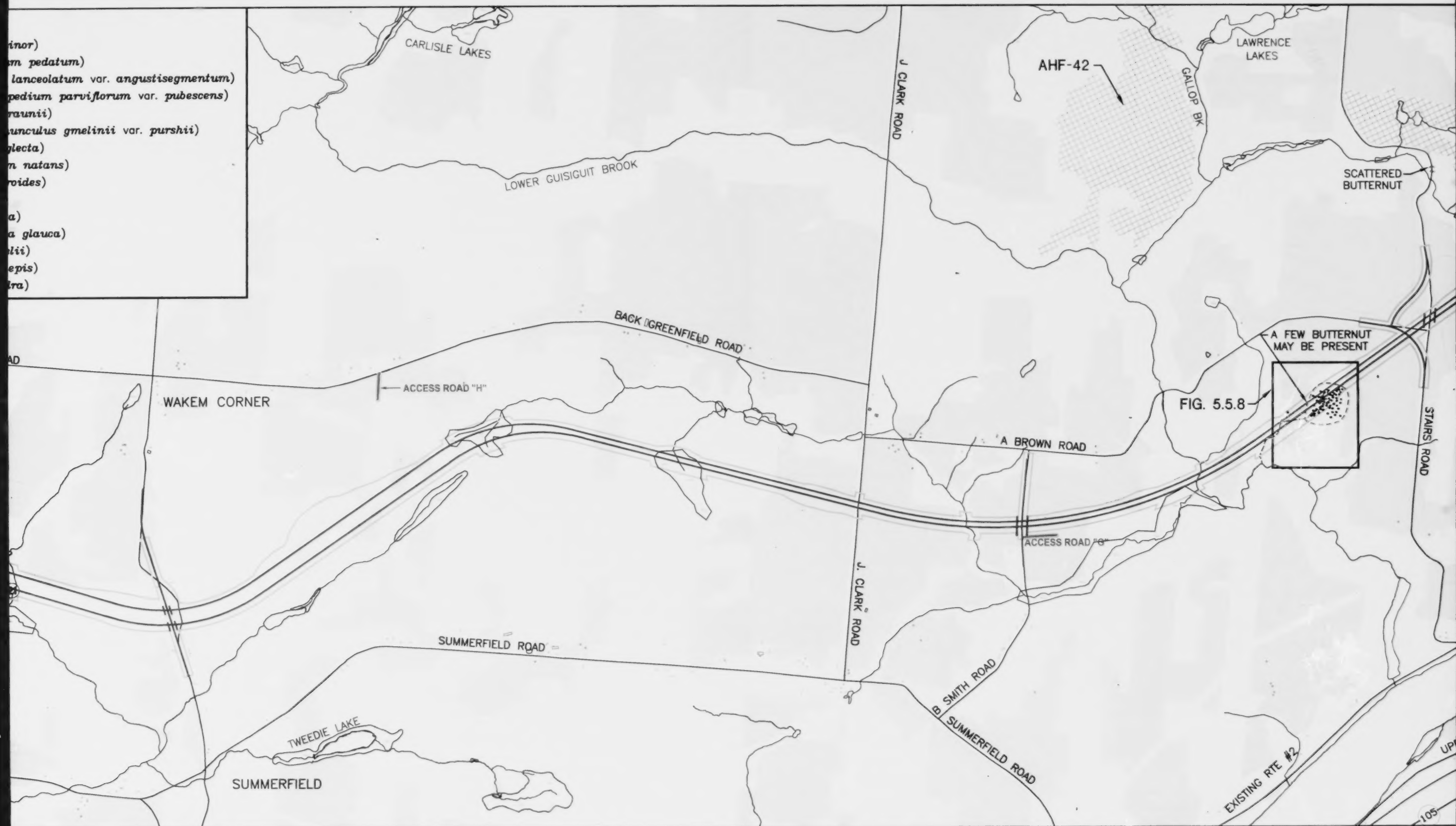
- 16 CANADA CLEARWEED (*Pilea pumila*)
- 17 LESSER BLADDERWORT (*Utricularia minor*)
- 18 NORTHERN MAIDENHAIR-FERN (*Adiantum pedatum*)
- 19 LANCE-LEAF GRAPEFERN (*Botrychium lanceolatum*)
- 20 LARGE YELLOW LADY'S-SLIPPER (*Cypripedium pubescens*)
- 21 BRAUN'S HOLLY FERN (*Polystichum braunii*)
- 22 SMALL YELLOW WATER-CROWFOOT (*Ranunculus repens*)
- 23 CLAMMY-HEDGE-HYSSOP (*Cratiola neglecta*)
- 24 SMALL-FRUITED BURREED (*Sparganium angustifolium*)
- 25 BLUE COHOSH (*Caulophyllum thalictroides*)
- 26 ROSY SEDGE (*Carex rosea*)
- 27 HEARTLEAF TWAYBLADE (*Listera cordata*)
- 28 FEN GRASS-OF-PARNASSUS (*Parnassia glauca*)
- 29 BLACK-SEED PLANTAIN (*Plantago rugelii*)
- 30 HIDDEN-SCALED SEDGE (*Carex cryptolepis*)
- 31 LESSER TUSsock SEDGE (*Carex diandra*)

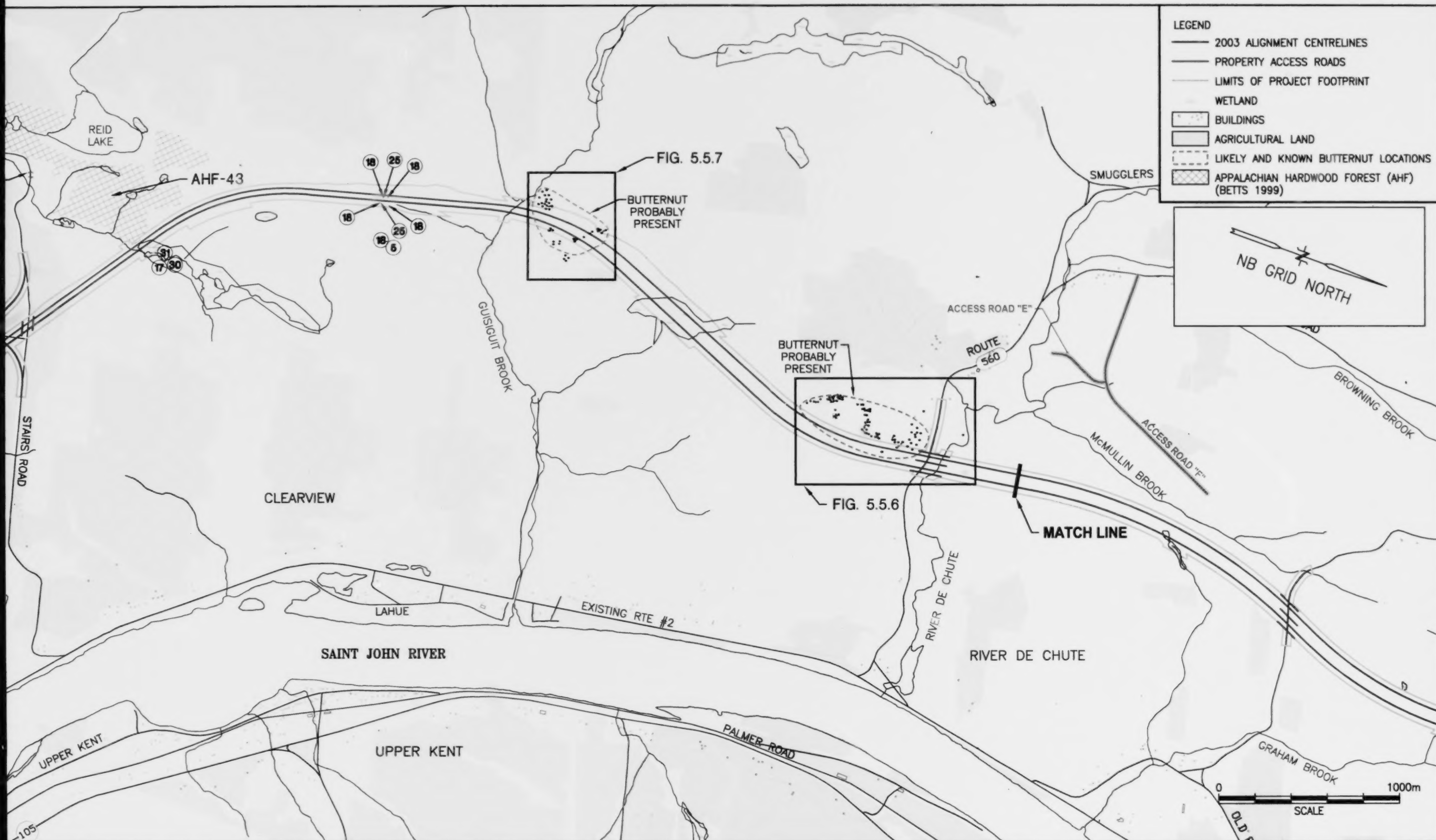


NOTE:

ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)

inor)
 m pedatum)
 lanceolatum var. angustisegmentum)
 pedium parviflorum var. pubescens)
 raunii)
 unculus gmelinii var. purshii)
 glecta)
 m natans)
 roides)
 a)
 a glauca)
 llii)
 epis)
 tra)





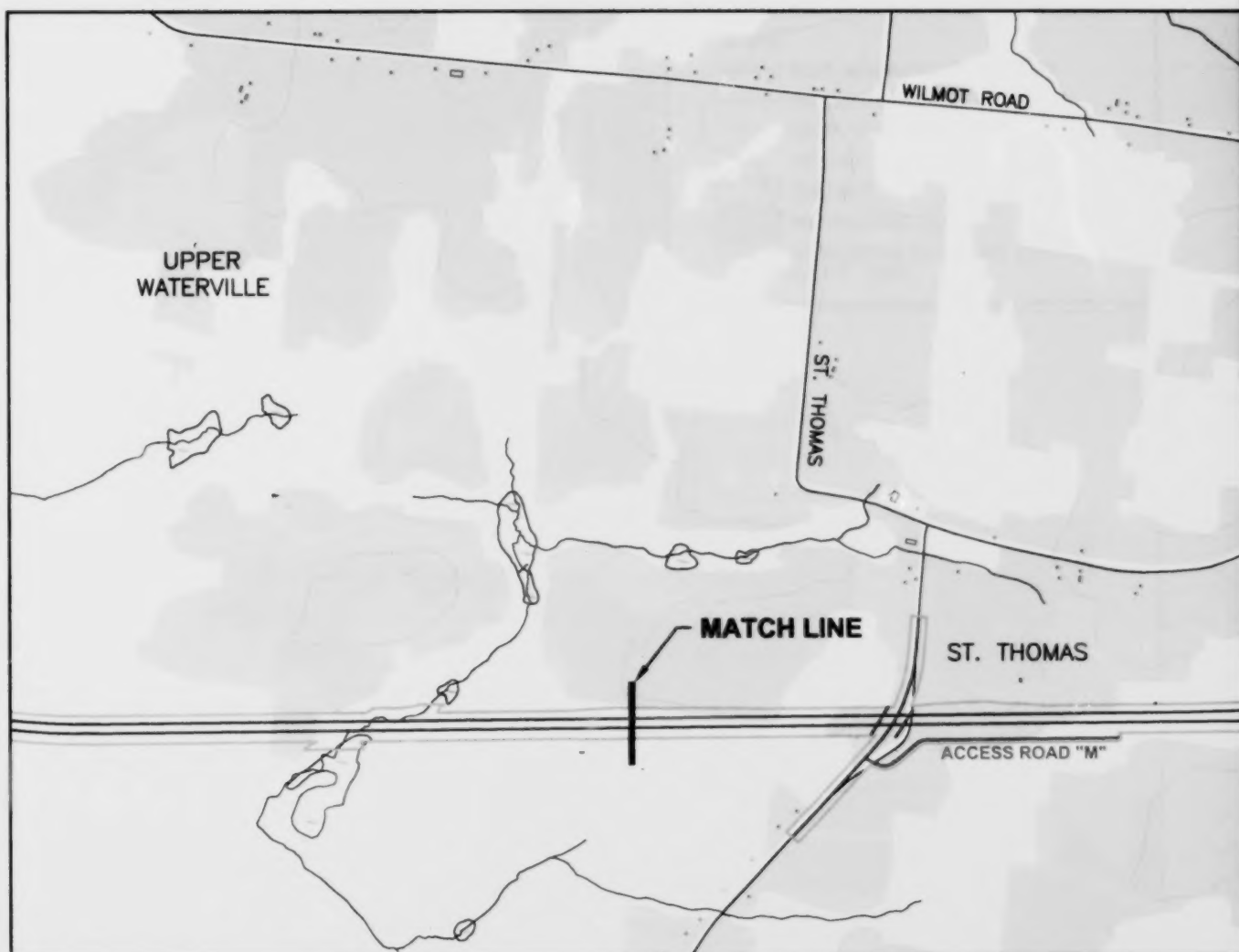
**RARE PLANTS AND APPALACHIAN HARDWOOD FOREST
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 04
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.5.1-B

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Consulting Engineers
Environmental Scientists

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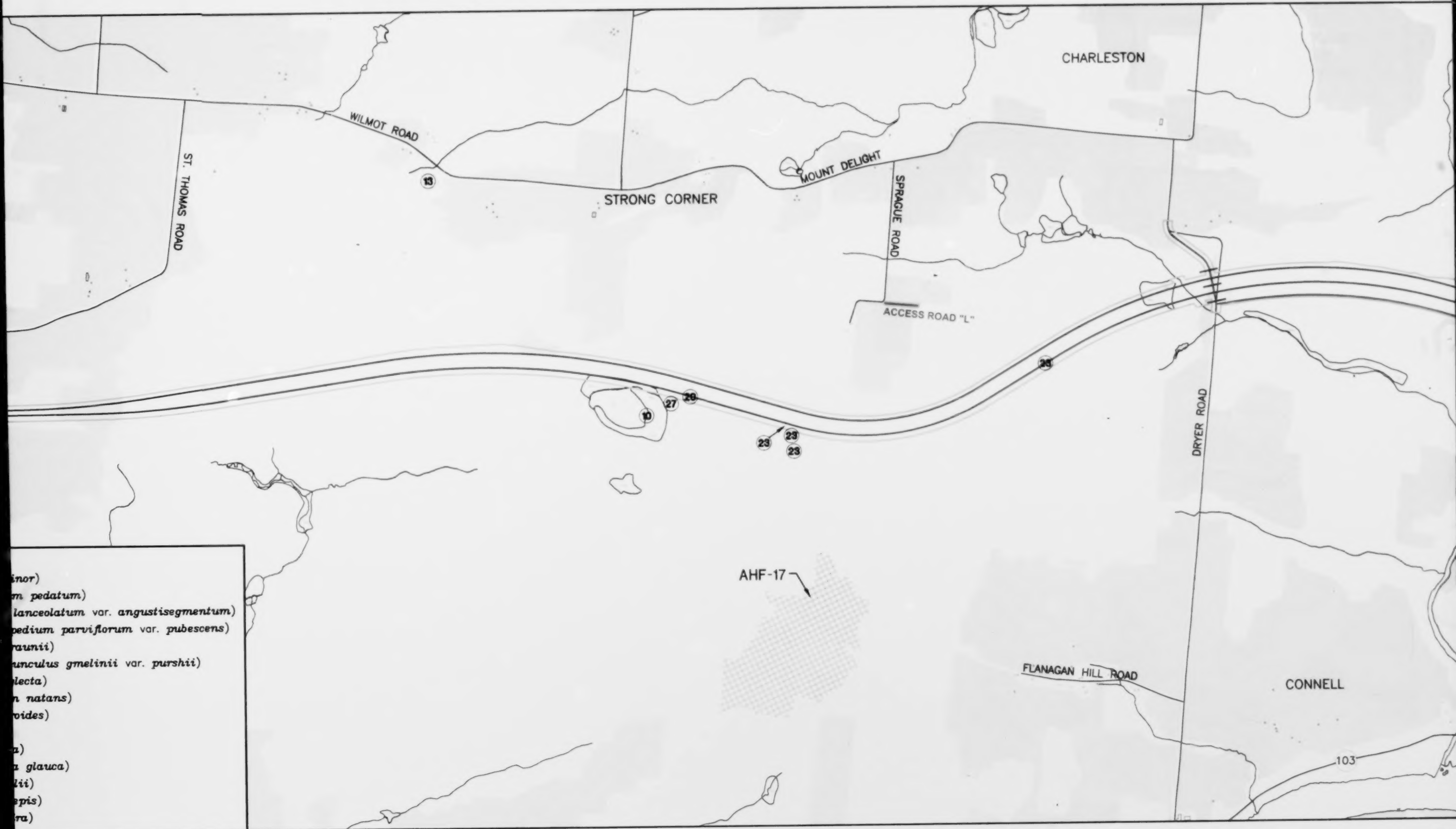


RARE PLANT LEGEND

- | | |
|---|--|
| ① BOTTLE-BRUSH GRASS (<i>Elymus hystrix</i>) | ⑩ CANADA CLEARWEED (<i>Pilea pumila</i>) |
| ② NODDING FESCUE (<i>Festuca subverticillata</i>) | ⑪ LESSER BLADDERWORT (<i>Utricularia minor</i>) |
| ③ PALE TOUCH-ME-NOT (<i>Impatiens pallida</i>) | ⑫ NORTHERN MAIDENHAIR-FERN (<i>Adiantum pedatum</i>) |
| ④ FRAGRANT BLACK SNAKE-ROOT (<i>Sanicula odorata</i>) | ⑬ LANCE-LEAF GRAPEFERN (<i>Botrychium lanceolatum</i>) |
| ⑤ LEATHERWOOD (<i>Dirca palustris</i>) | ⑭ LARGE YELLOW LADY'S-SLIPPER (<i>Cypripedium</i>) |
| ⑥ CANADA VIOLET (<i>Viola canadensis</i>) | ⑮ BRAUN'S HOLLY FERN (<i>Polystichum braunii</i>) |
| ⑦ CALYPSO OR VENUS' SLIPPER (<i>Calypso bulbosa</i>) | ⑯ SMALL YELLOW WATER-CROWFOOT (<i>Ranunculus</i>) |
| ⑧ MOUNTAIN VALERIAN (<i>Valeriana uliginosa</i>) | ⑰ CLAMMY-HEDGE-HYSSOP (<i>Gratiola neglecta</i>) |
| ⑨ HOOKED AGRIMONY (<i>Agrimonia gryposepala</i>) | ⑱ SMALL-FRUITED BURREED (<i>Sparganium natans</i>) |
| ⑩ BOREAL BOG SEDGE (<i>Carex magellanica</i> ssp. <i>magellanica</i>) | ⑲ BLUE COHOSH (<i>Caulophyllum thalictroides</i>) |
| ⑪ PLANTAIN-LEAVED SEDGE (<i>Carex plantaginea</i>) | ⑳ ROSY SEDGE (<i>Carex rosea</i>) |
| ⑫ SPRENGEL'S SEDGE (<i>Carex sprengelii</i>) | ㉑ HEARTLEAF TWAYBLADE (<i>Listera cordata</i>) |
| ⑬ SHOWY LADY'S-SLIPPER (<i>Cypripedium reginae</i>) | ㉒ FEN GRASS-OF-PARNASSUS (<i>Parnassia glauca</i>) |
| ⑭ GOLDIE'S FERN (<i>Dryopteris goldiana</i>) | ㉓ BLACK-SEED PLANTAIN (<i>Plantago rugelii</i>) |
| ⑮ LOPSEED (<i>Phryma leptostachya</i>) | ㉔ HIDDEN-SCALED SEDGE (<i>Carex cryptolepis</i>) |
| | ㉕ LESSER TUSsock SEDGE (<i>Carex diandra</i>) |

NOTE:

ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)



inor)
m pedatum)
lanceolatum var. angustisegmentum)
pedium parviflorum var. pubescens)
raunii)
unculus gmelinii var. purshii)
lecta)
n natans)
oides)
a)
a glauca)
lii)
epis)
ra)



**RARE PLANTS AND APPALACHIAN HARDWOOD FOREST
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

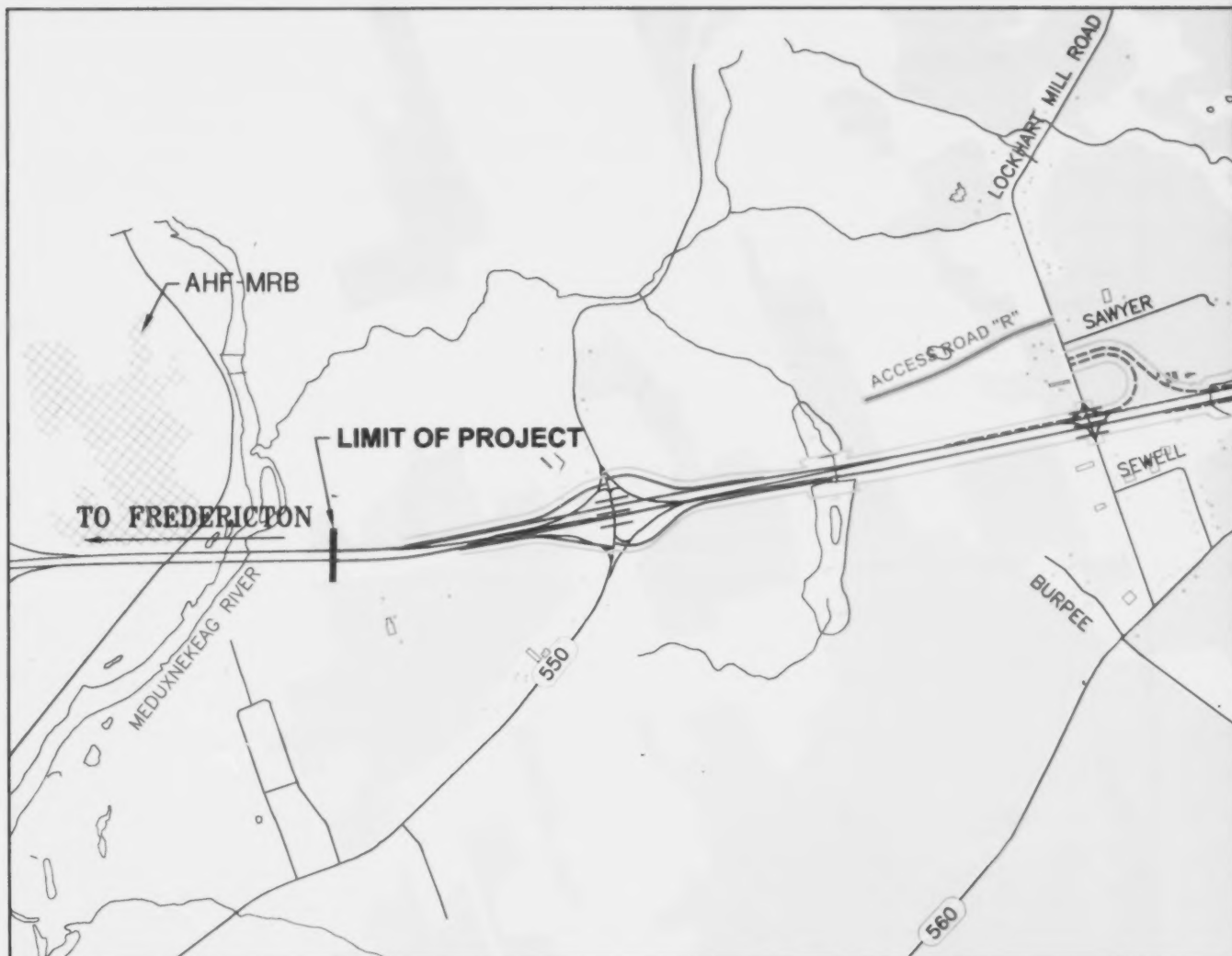
Date: 2004 02 03
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.5.1-C



Jacques Whitford
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Environmental Scientists

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RARE PLANT LEGEND

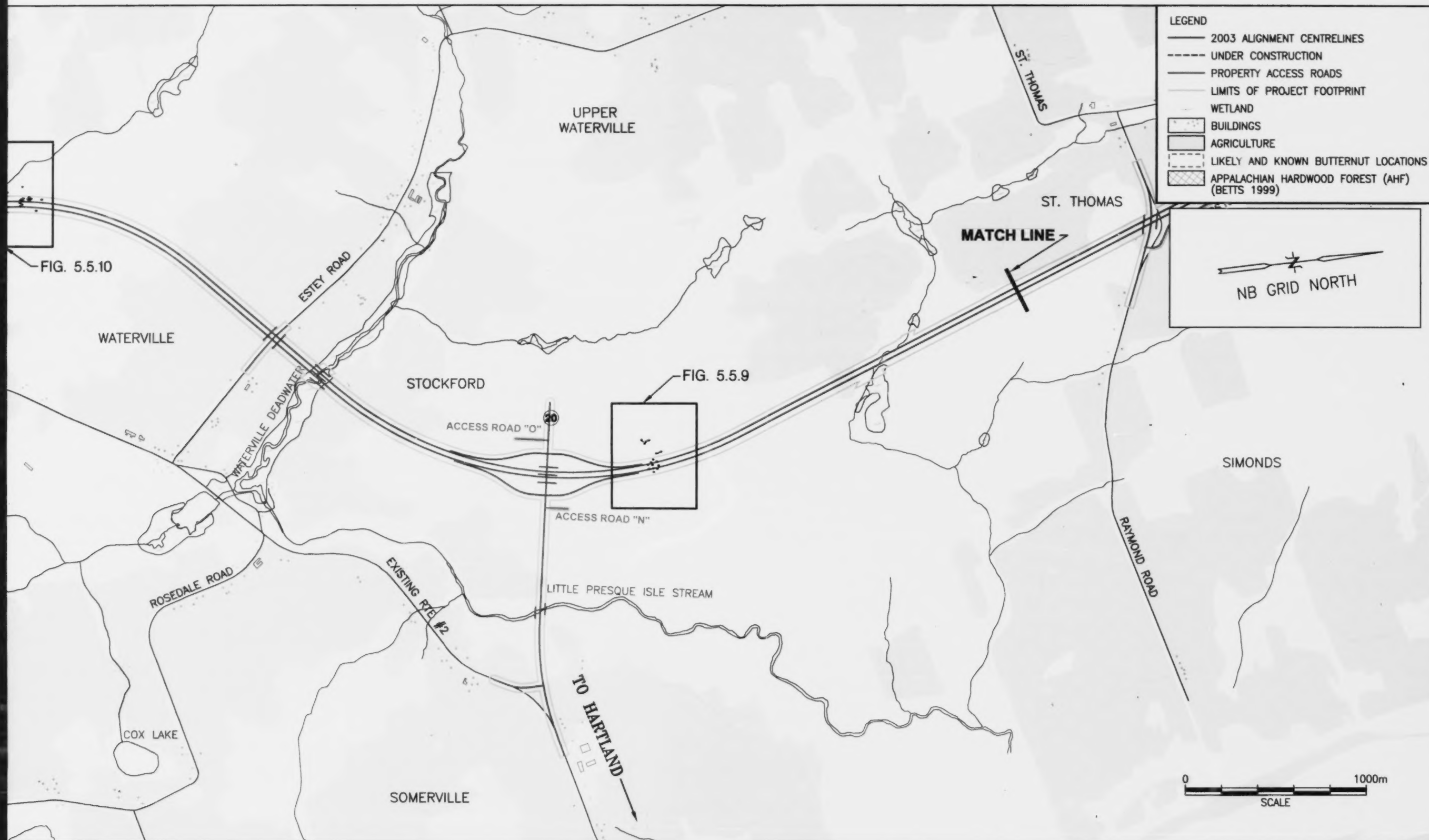
- | | |
|---|--|
| ① BOTTLE-BRUSH GRASS (<i>Elymus hystrix</i>) | ⑩ CANADA CLEARWEED (<i>Pilea pumila</i>) |
| ② NODDING FESCUE (<i>Festuca subverticillata</i>) | ⑪ LESSER BLADDERWORT (<i>Utricularia minor</i>) |
| ③ PALE TOUCH-ME-NOT (<i>Impatiens pallida</i>) | ⑫ NORTHERN MAIDENHAIR-FERN (<i>Adiantum pedatum</i>) |
| ④ FRAGRANT BLACK SNAKE-ROOT (<i>Sanicula odorata</i>) | ⑬ LANCE-LEAF GRAPEFERN (<i>Botrychium lanceolatum</i>) |
| ⑤ LEATHERWOOD (<i>Dirca palustris</i>) | ⑭ LARGE YELLOW LADY'S-SLIPPER (<i>Cypripedium pubescens</i>) |
| ⑥ CANADA VIOLET (<i>Viola canadensis</i>) | ⑮ BRAUN'S HOLLY FERN (<i>Polystichum braunii</i>) |
| ⑦ CALYPSO OR VENUS' SLIPPER (<i>Calypso bulbosa</i>) | ⑯ SMALL YELLOW WATER-CROWFOOT (<i>Ranunculus repens</i>) |
| ⑧ MOUNTAIN VALERIAN (<i>Valeriana uliginosa</i>) | ⑰ CLAMMY-HEDGE-HYSSOP (<i>Gratiola neglecta</i>) |
| ⑨ HOOKED AGRIMONY (<i>Agrimonia gryposepala</i>) | ⑱ SMALL-FRUITED BURREED (<i>Sparganium angustifolium</i>) |
| ⑩ BOREAL BOG SEDGE (<i>Carex magellanica</i> ssp. <i>magellanica</i>) | ⑲ BLUE COHOSH (<i>Caulophyllum thalictroides</i>) |
| ⑪ PLANTAIN-LEAVED SEDGE (<i>Carex plantaginea</i>) | ⑳ ROSY SEDGE (<i>Carex rosea</i>) |
| ⑫ SPRENGEL'S SEDGE (<i>Carex sprengelii</i>) | ㉑ HEARTLEAF TWAYBLADE (<i>Listera cordata</i>) |
| ⑬ SHOWY LADY'S-SLIPPER (<i>Cypripedium reginae</i>) | ㉒ FEN GRASS-OF-PARNASSUS (<i>Parnassia glauca</i>) |
| ⑭ GOLDIE'S FERN (<i>Dryopteris goldiana</i>) | ㉓ BLACK-SEED PLANTAIN (<i>Plantago rugelii</i>) |
| ⑮ LOPSEED (<i>Phryma leptostachya</i>) | ㉔ HIDDEN-SCALED SEDGE (<i>Carex cryptolepis</i>) |
| | ㉕ LESSER TUSsock SEDGE (<i>Carex diandra</i>) |

NOTE:

ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)



- minor)
- tum pedatum)
- n lanceolatum var. angustisegmentum)
- ripedium parviflorum var. pubescens)
- braunii)
- anunculus gmelinii var. purshii)
- eglecta)
- um natans)
- etroides)
- ata)
- sia glauca)
- gelii)
- olepis)
- ndra)



**RARE PLANTS AND APPALACHIAN HARDWOOD FOREST
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.5.1-D



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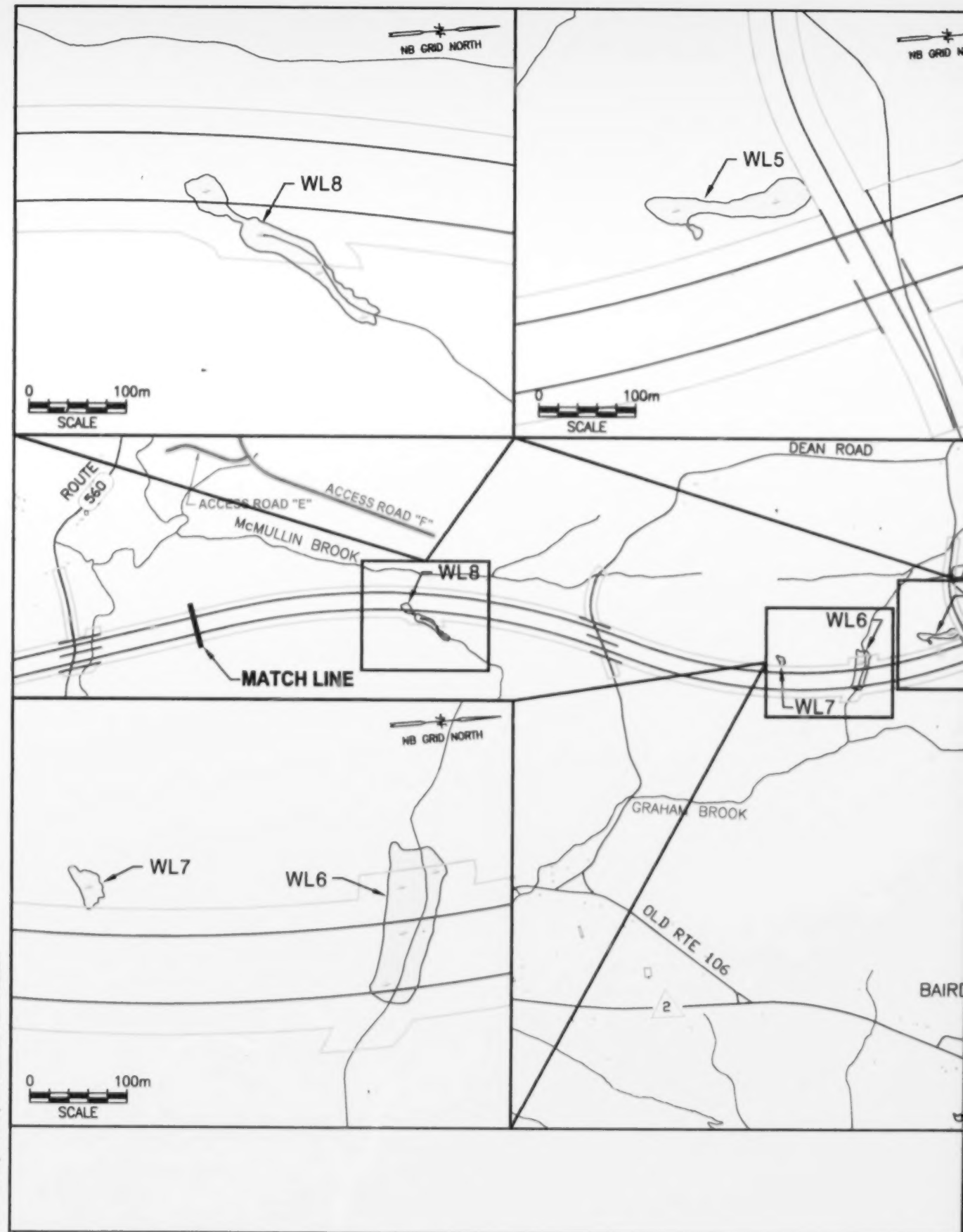
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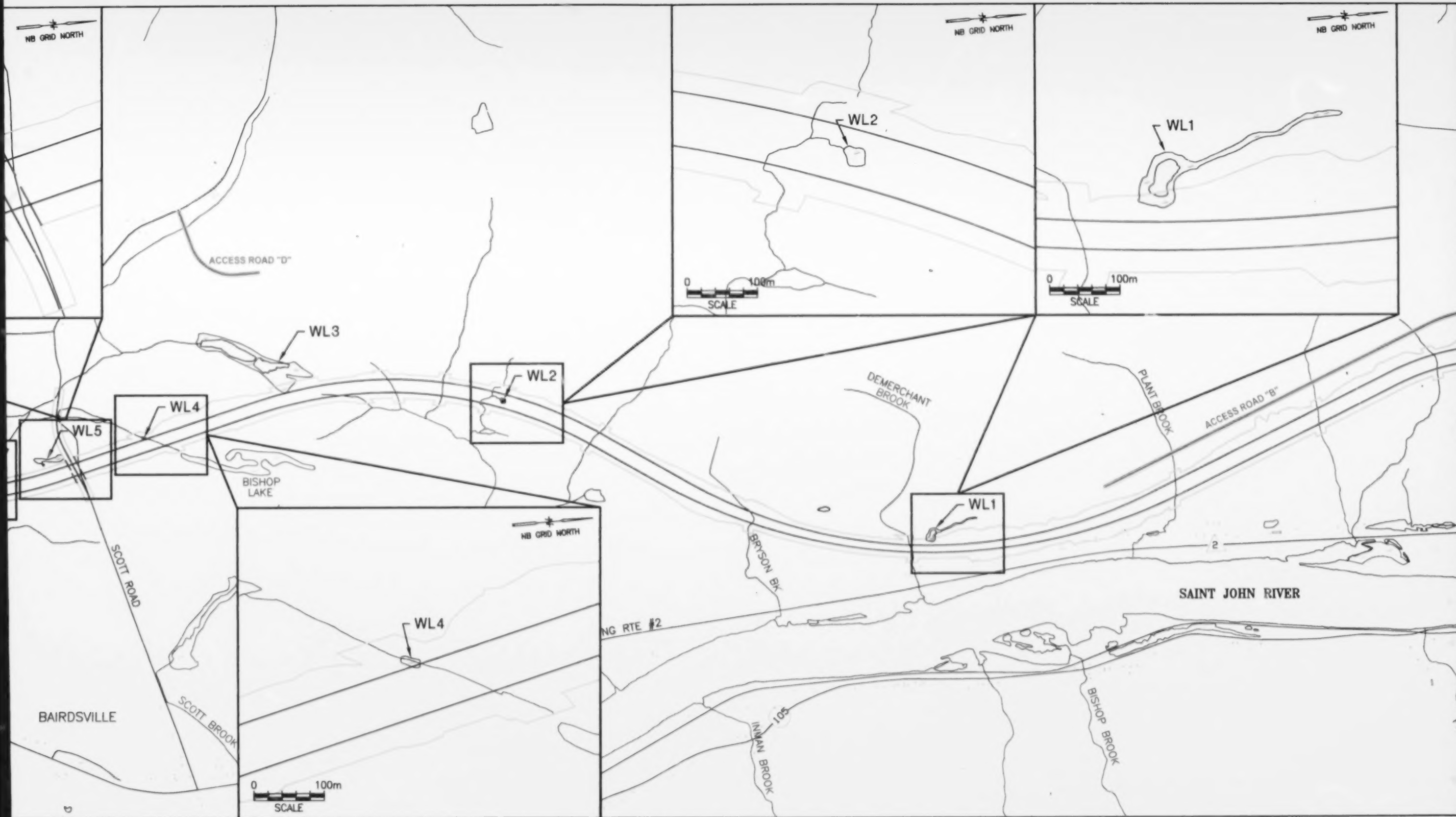
APPENDIX E
WETLANDS





FILE: 14677\WORKING\PERTHANDOVER-FLORENCEVILLE



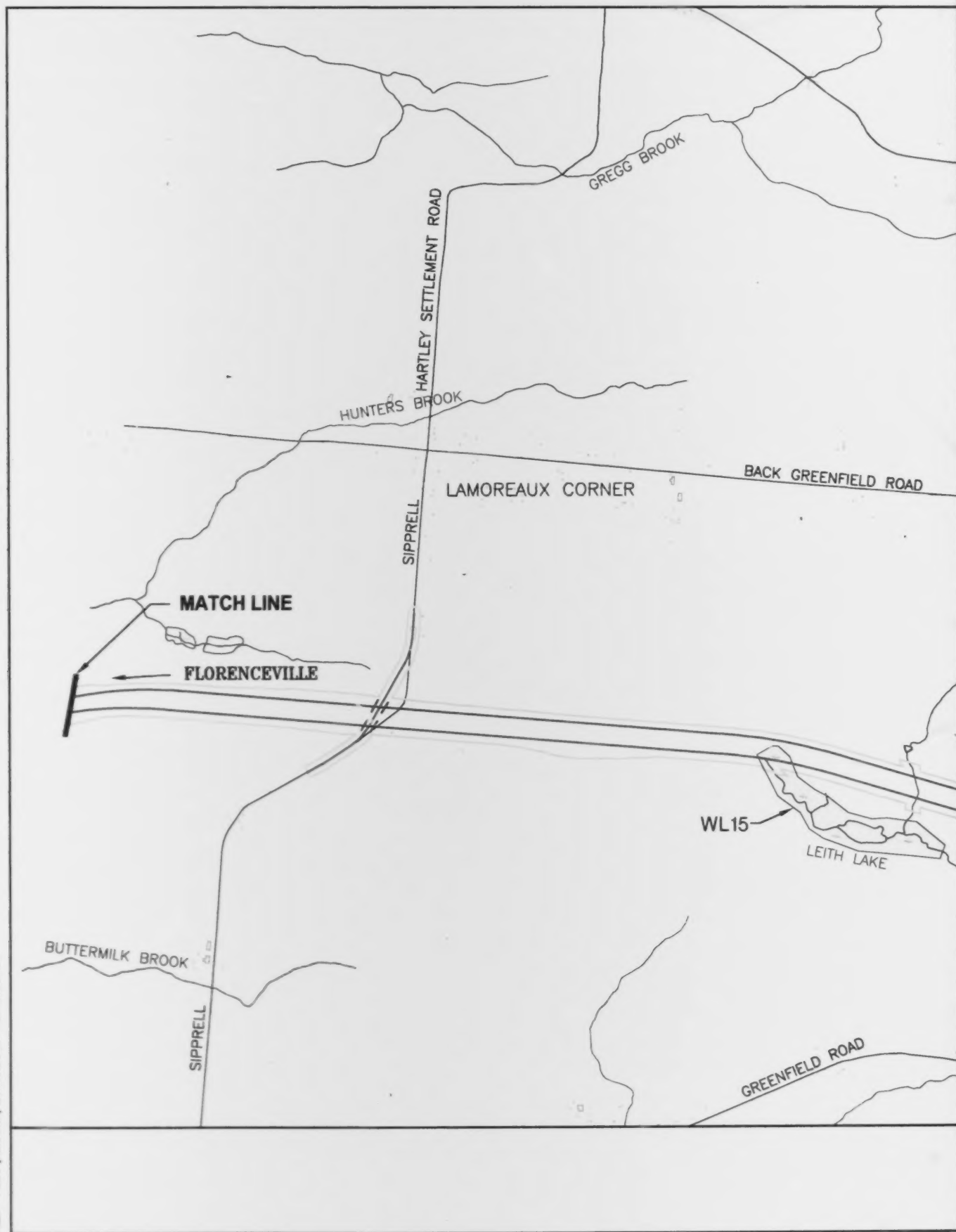


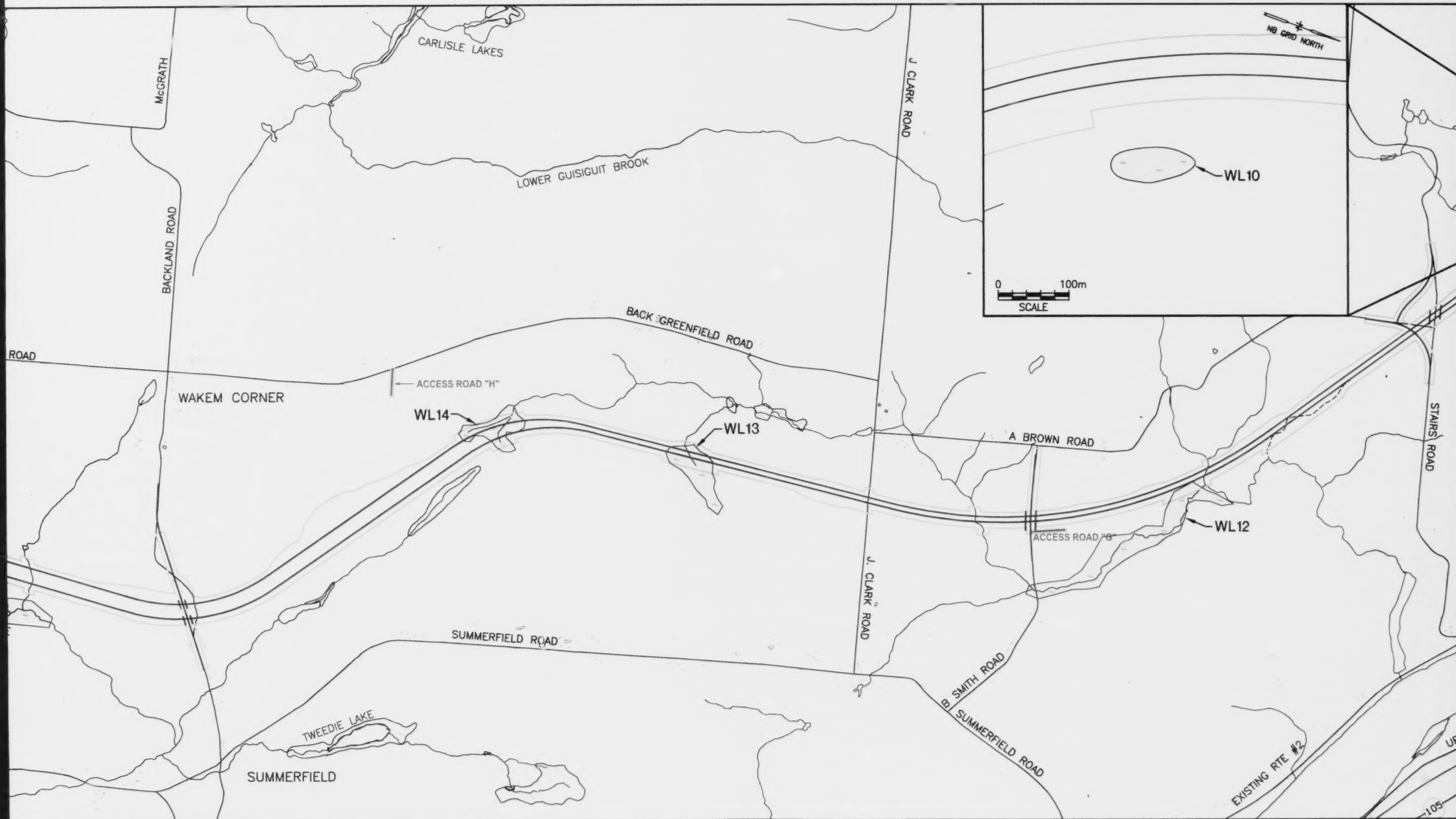


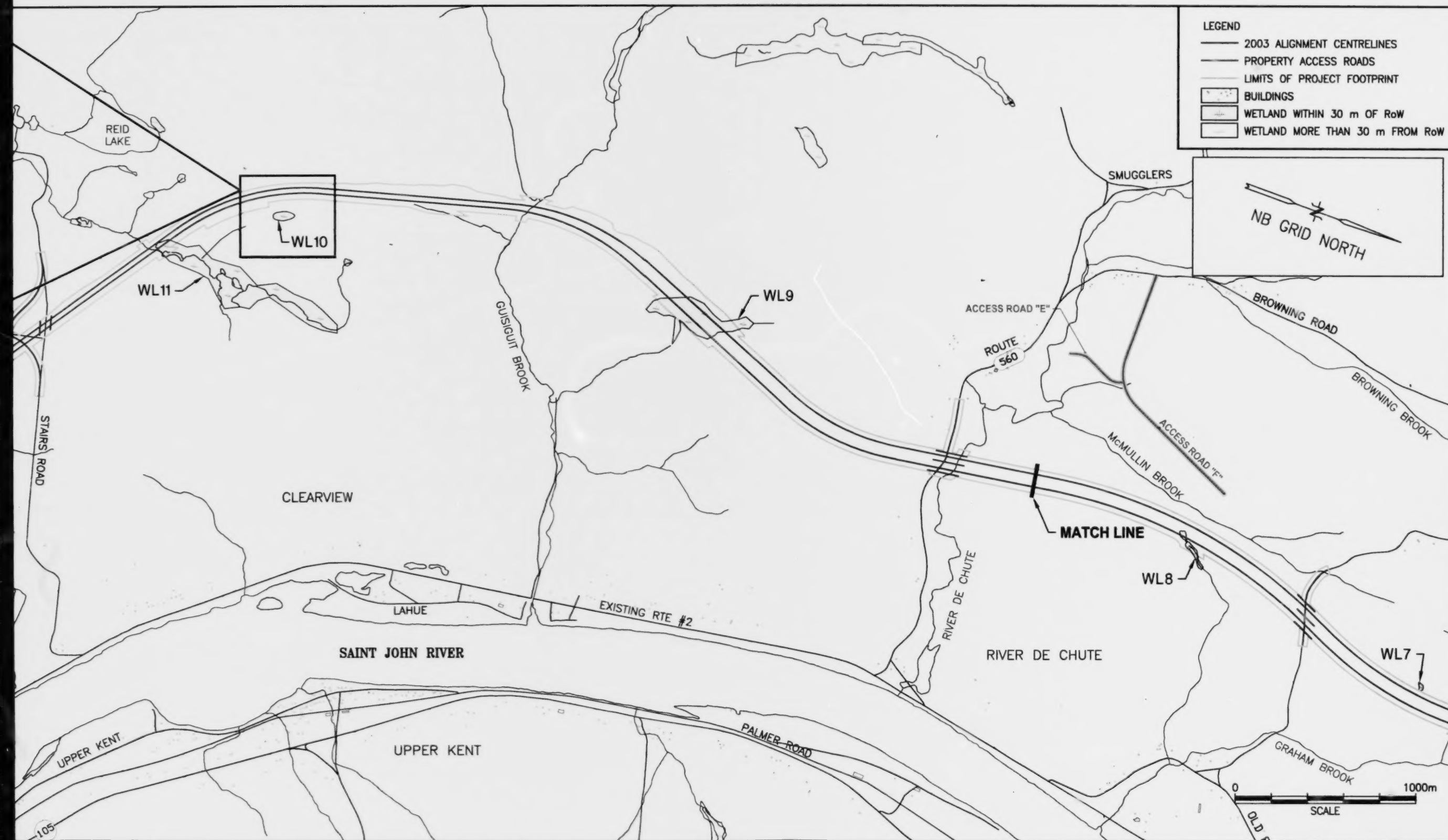
**WETLANDS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date:	2004 02 12	Scale:	1 : 20 000	 Jacques Whitford Consulting Engineers Environmental Scientists
Job No.:	14677	Fig. No.:	5.6.1-A	

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WETLANDS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date: 2004 02 12
 Job No.: 14677

Scale: 1 : 20 000
 Fig. No.: 5.6.1-B



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UPPER
WATERVILLE

WILMOT ROAD

ST. THOMAS

MATCH LINE

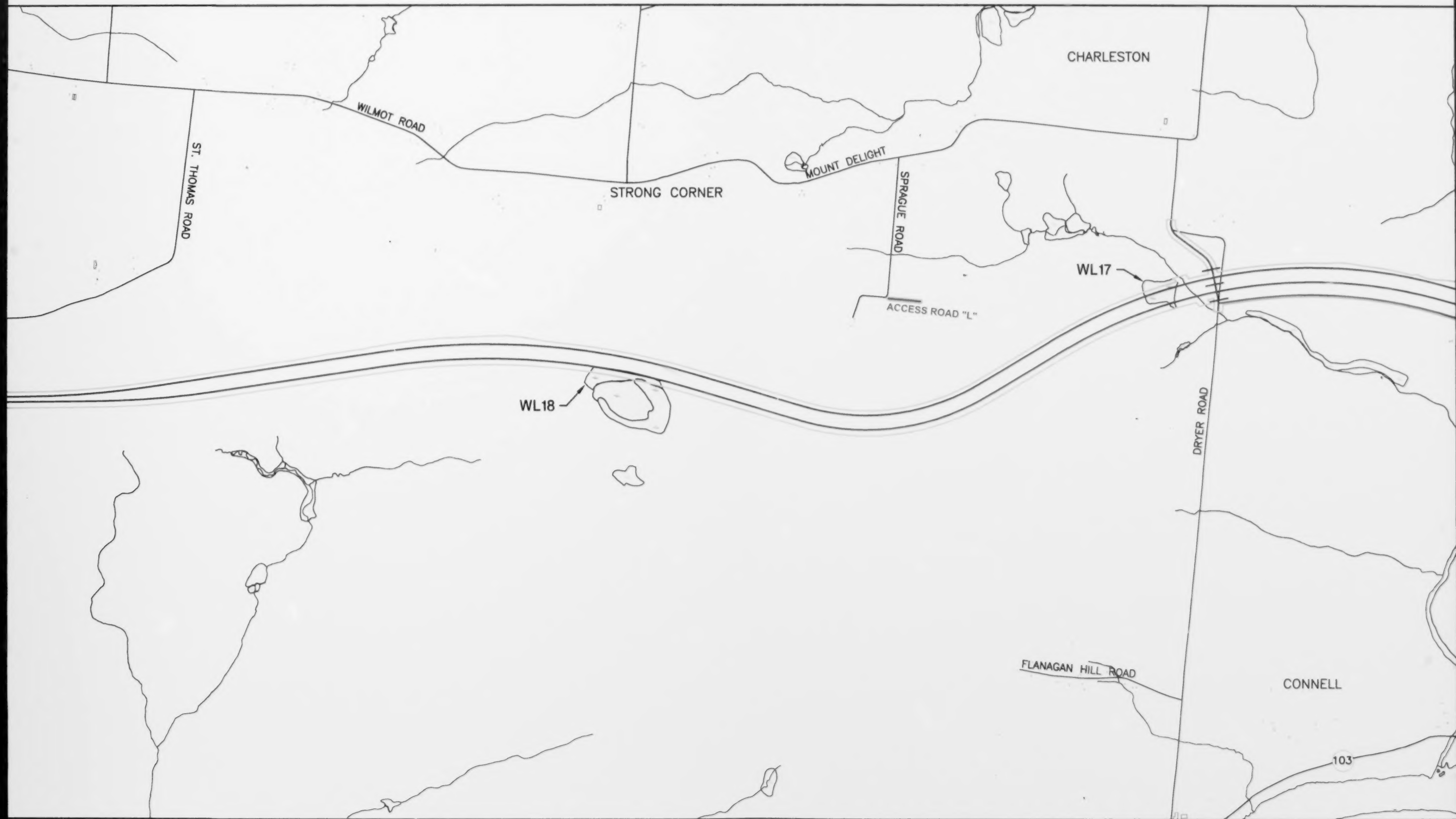
ST. THOMAS

ACCESS ROAD "M"

WL19

RAYMOND ROAD

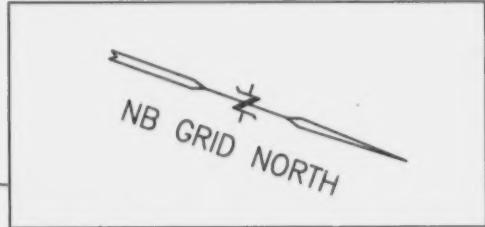
SIMONDS





LEGEND

- 2003 ALIGNMENT CENTRELINES
- PROPERTY ACCESS ROADS
- LIMITS OF PROJECT FOOTPRINT
- [Pattern] BUILDINGS
- [Pattern] WETLAND WITHIN 30 m OF RoW
- [Pattern] WETLAND MORE THAN 30 m FROM RoW



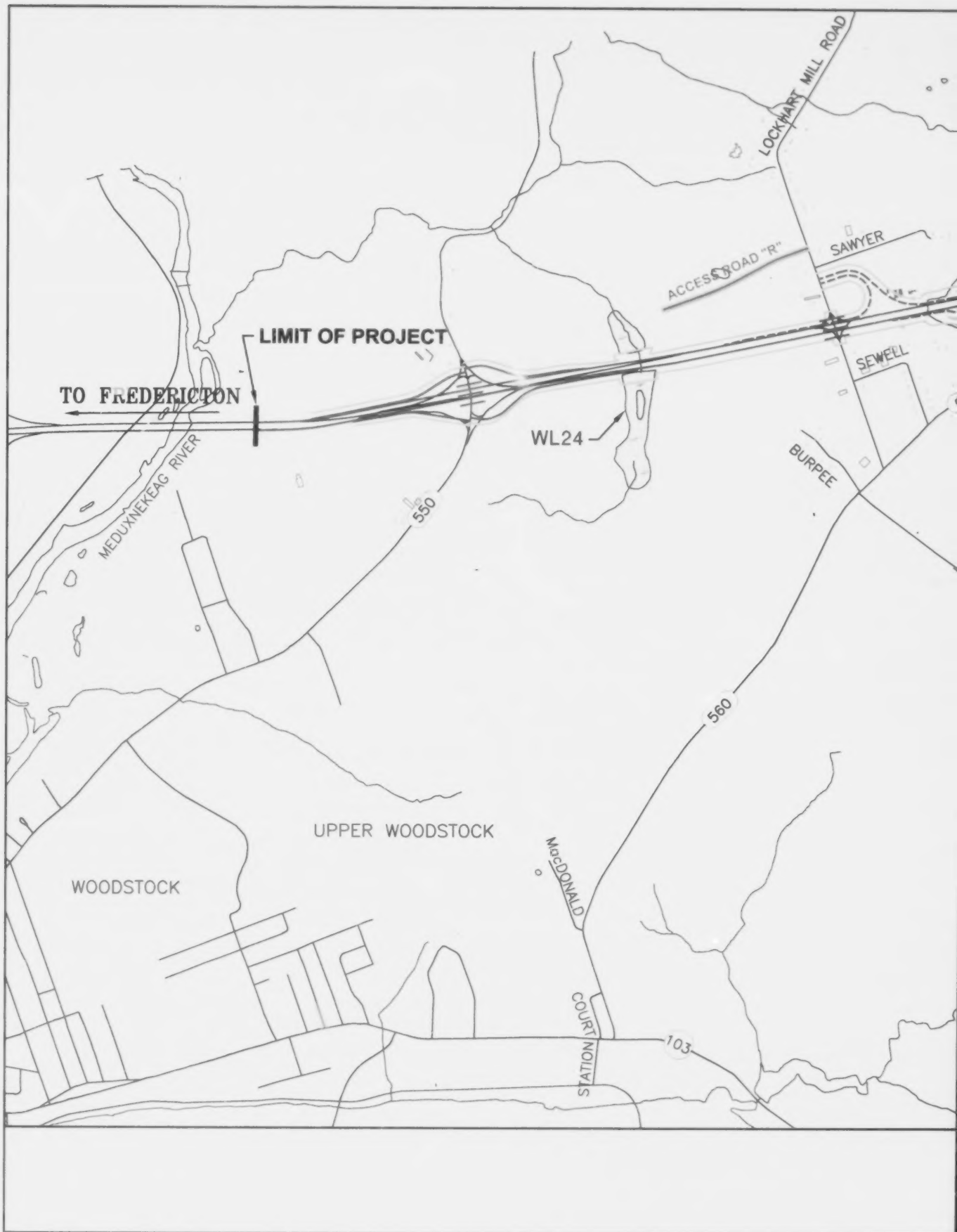
WETLANDS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

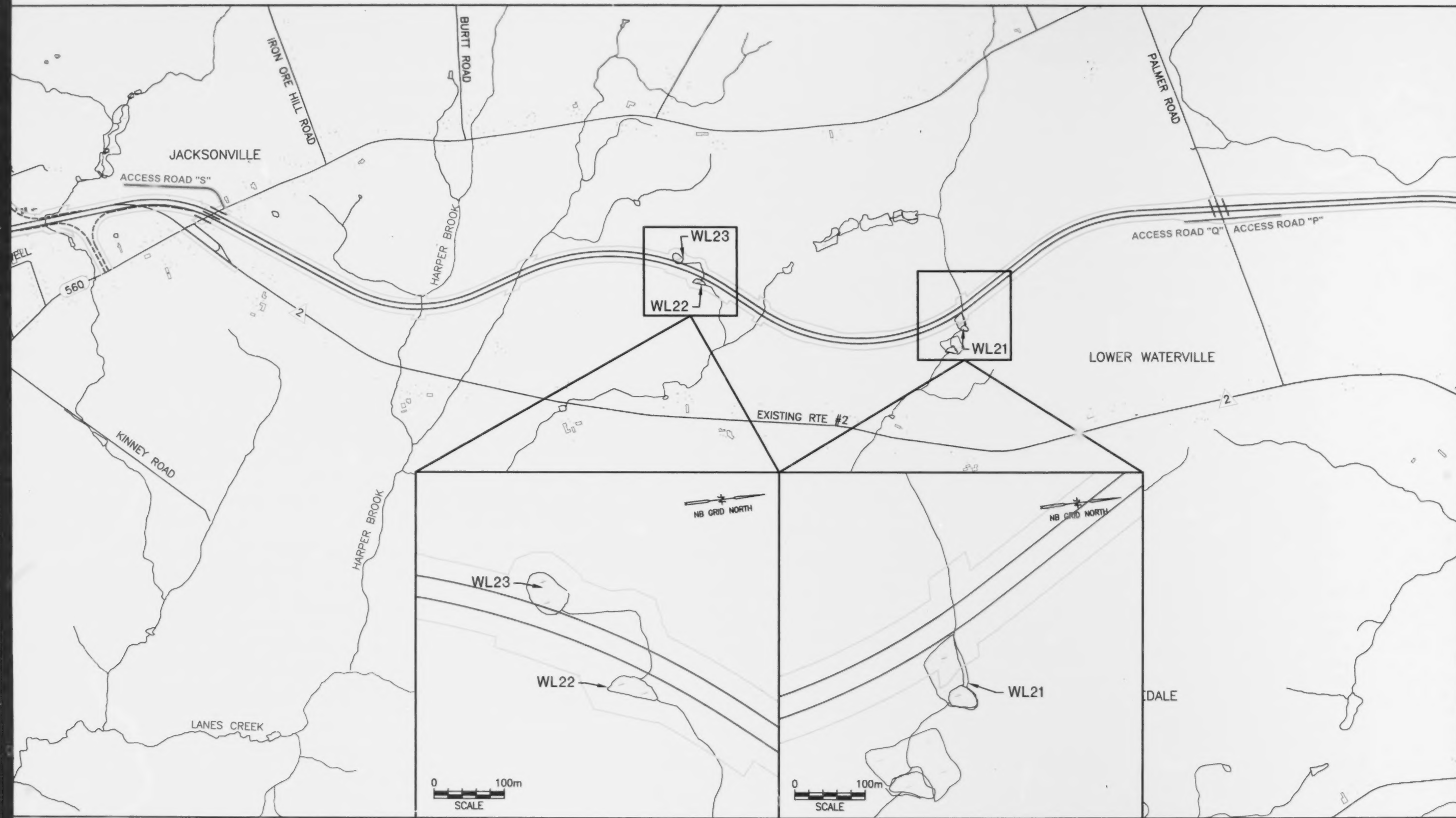
Date:	2004 02 03	Scale:	1 : 20 000
Job No.:	14677	Fig. No.:	5.6.1-C

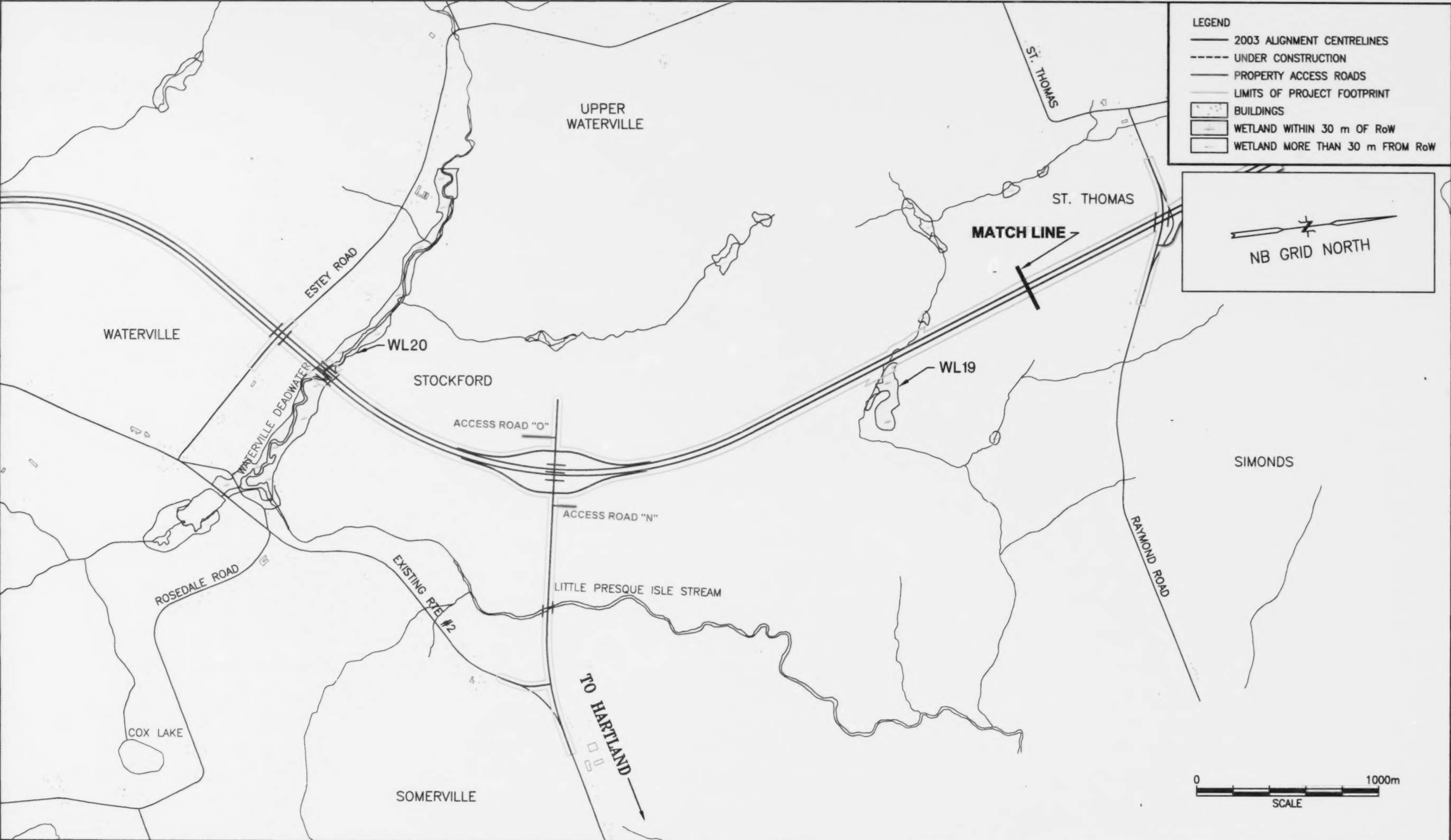


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WETLANDS
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

Date:	2004 02 03	Scale:	1 : 20 000
Job No.:	14677	Fig. No.:	5.6.1-D

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Environmental Scientists

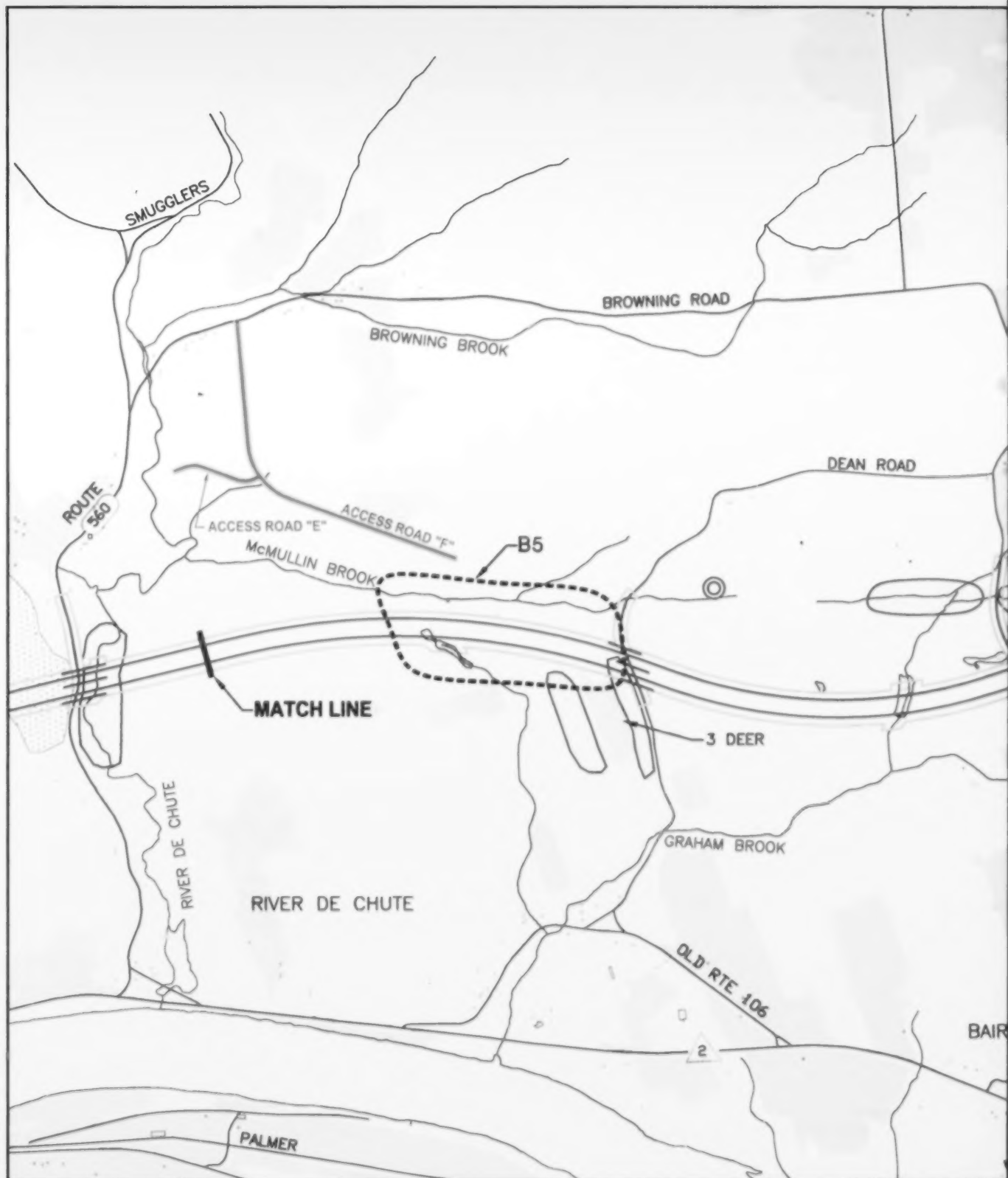
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APPENDIX F

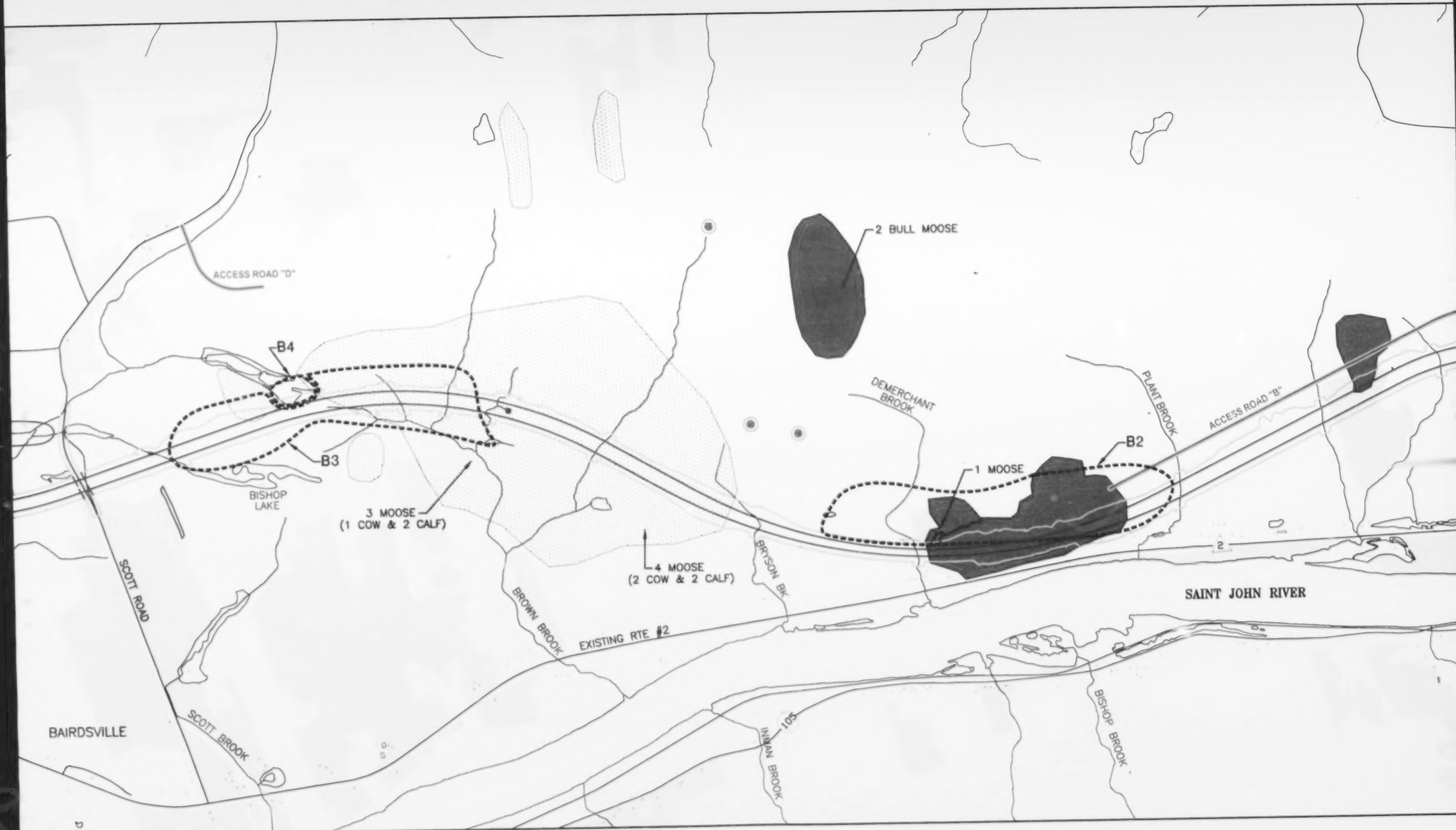
WILDLIFE







NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)



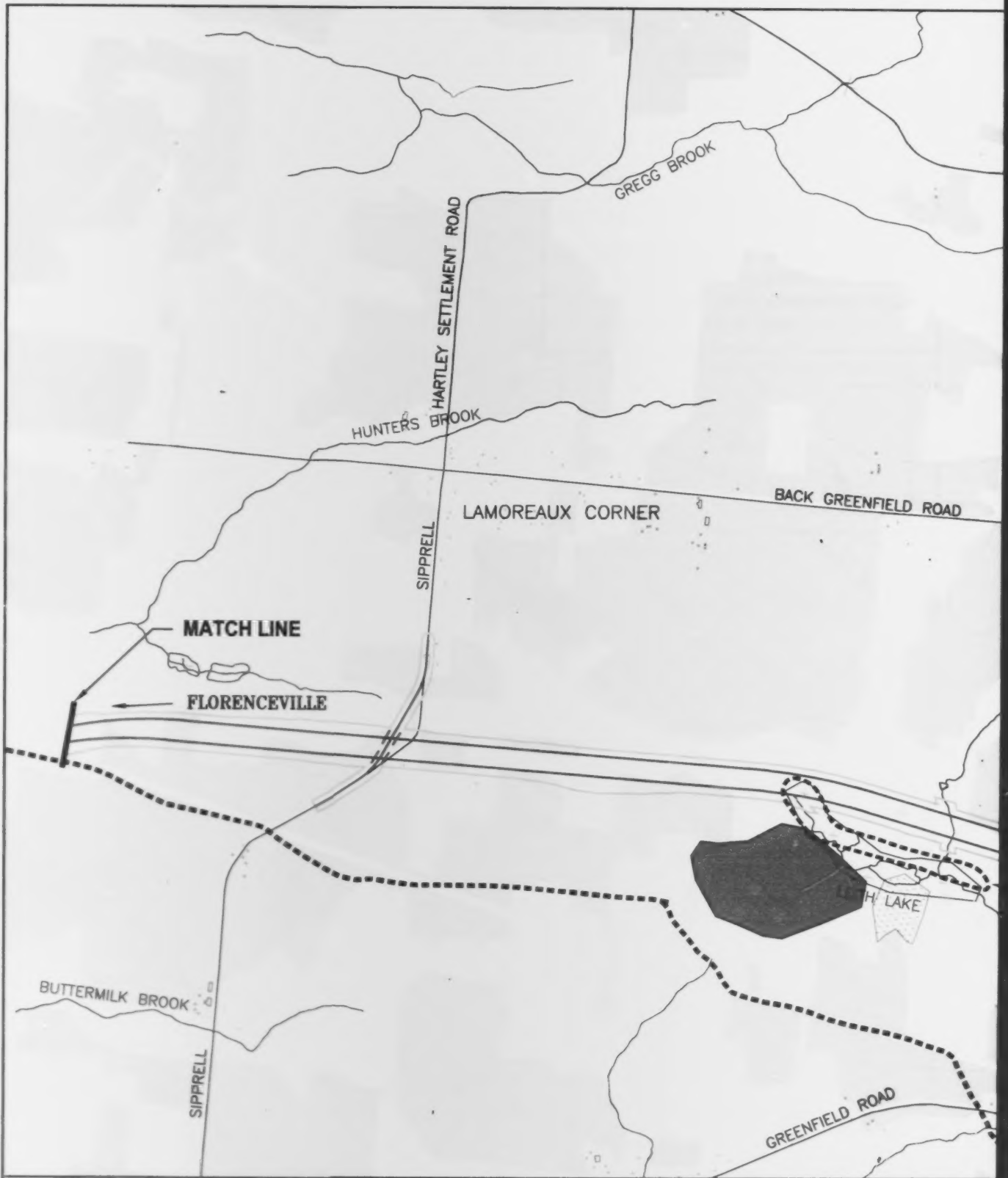


UNGULATE AERIAL SURVEY RESULTS AND BIRD SURVEY SITES
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK

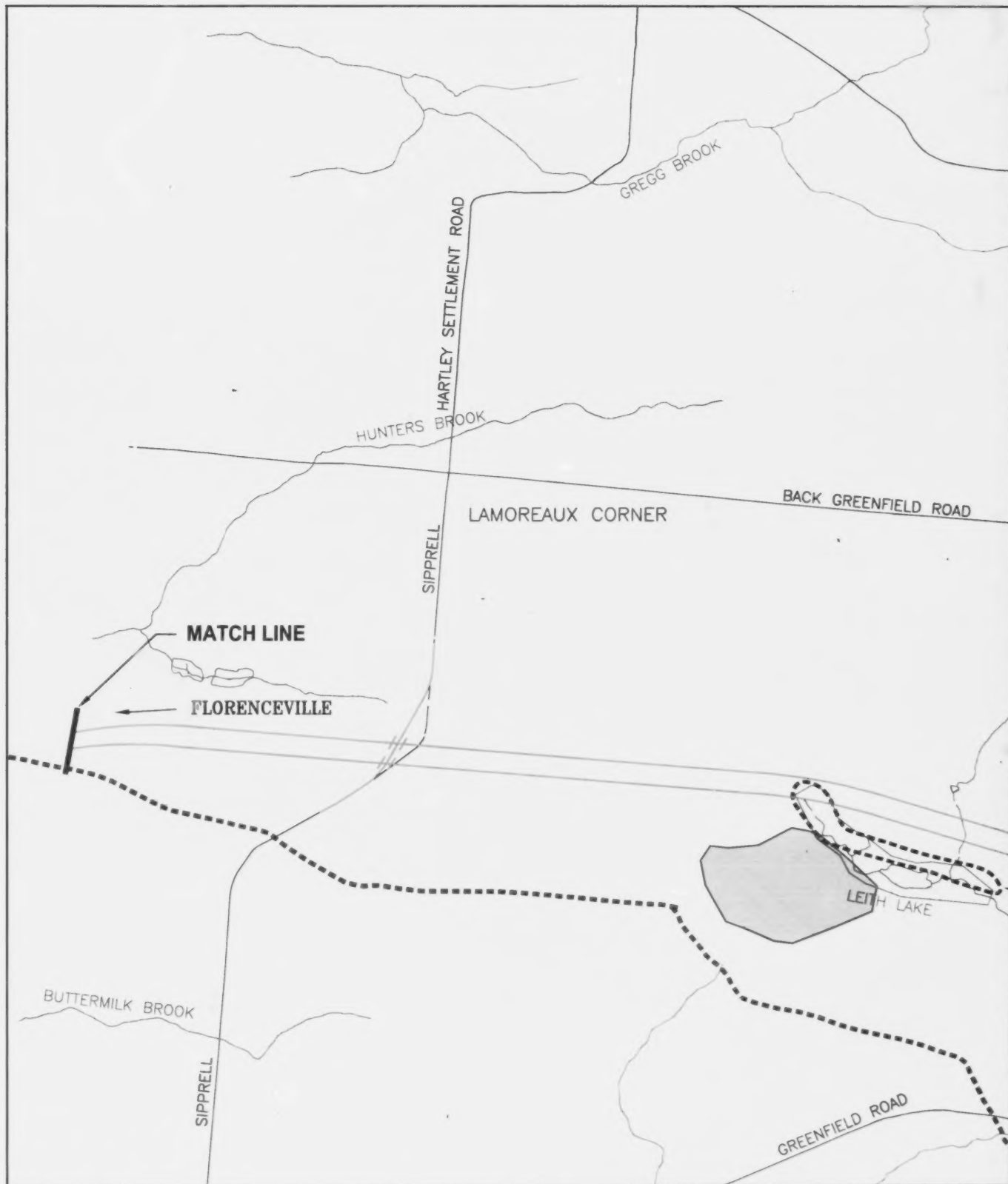
Date: 2004 02 12
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.7.1-A

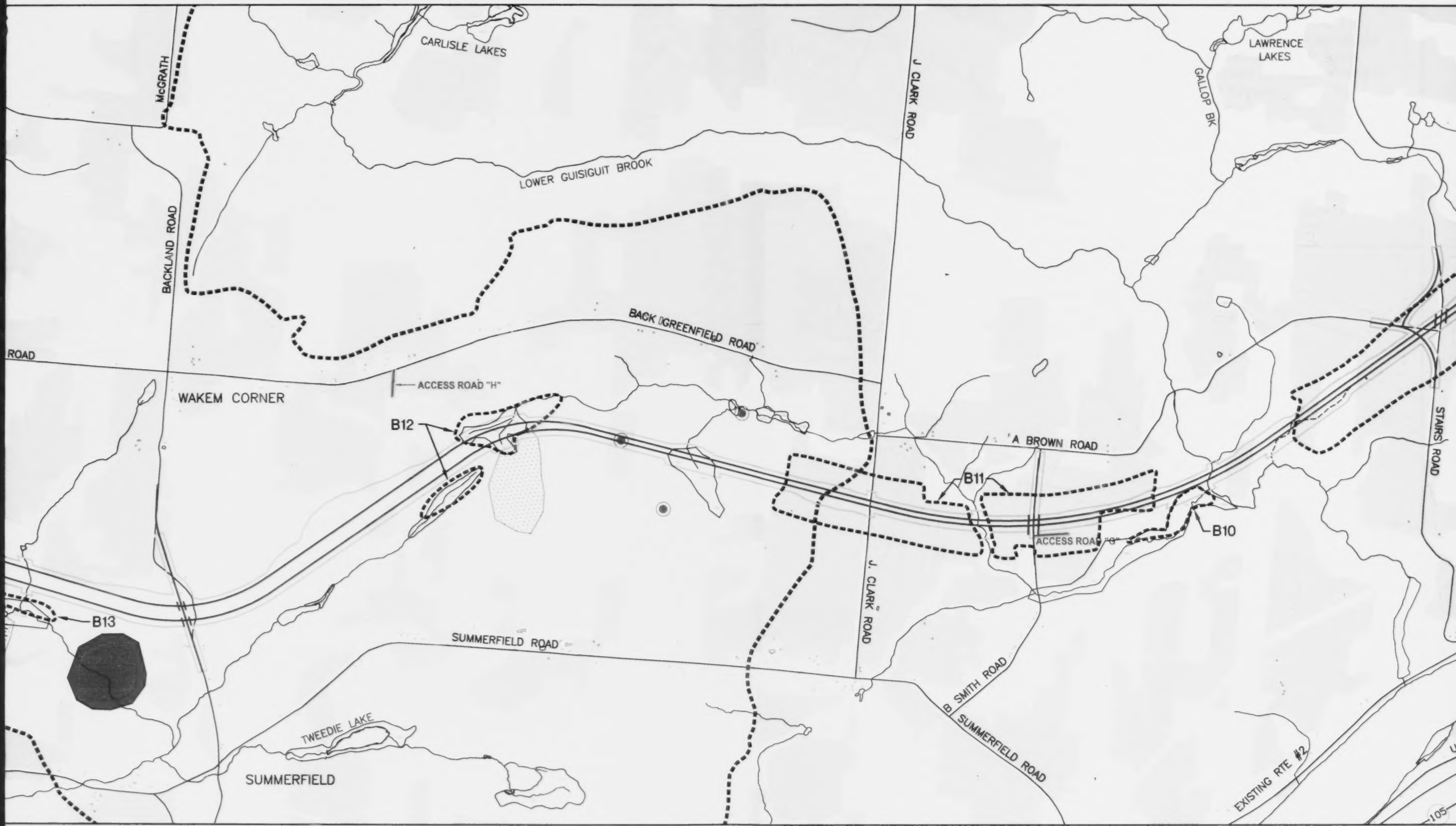
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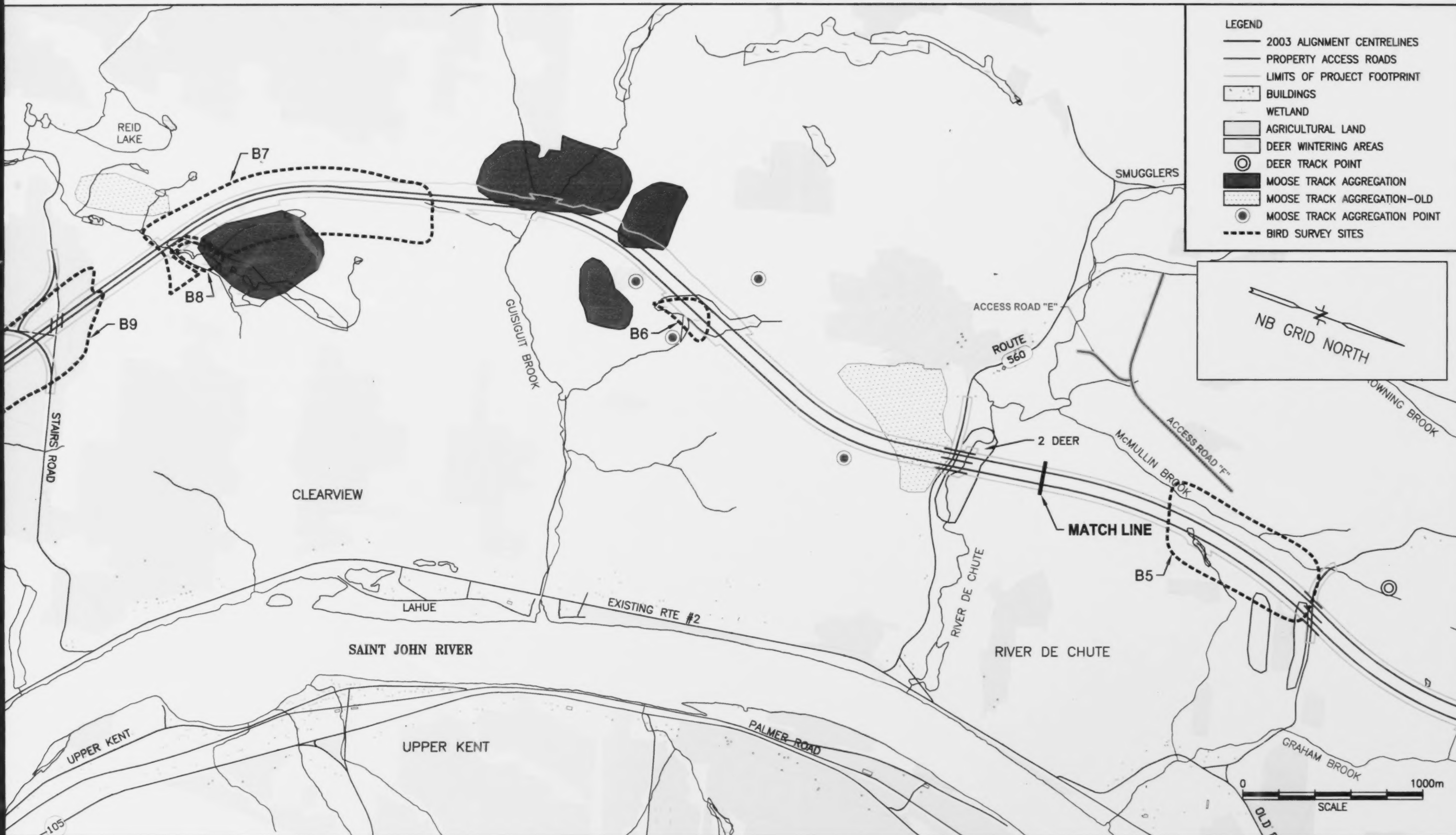


NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)



NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)





**UNGULATE AERIAL SURVEY RESULTS AND BIRD SURVEY SITES
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

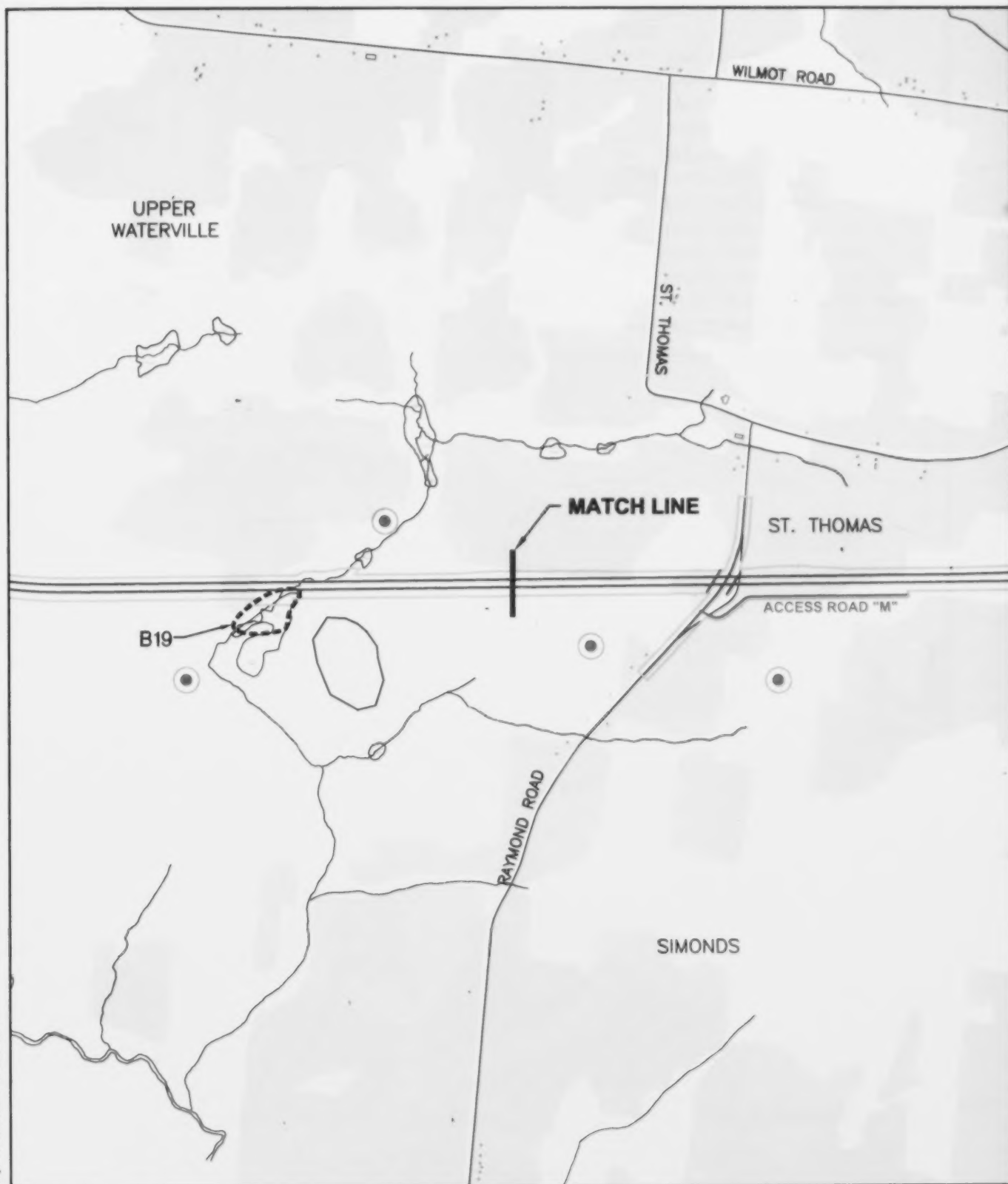
Date: 2004 02 12
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.7.1-B

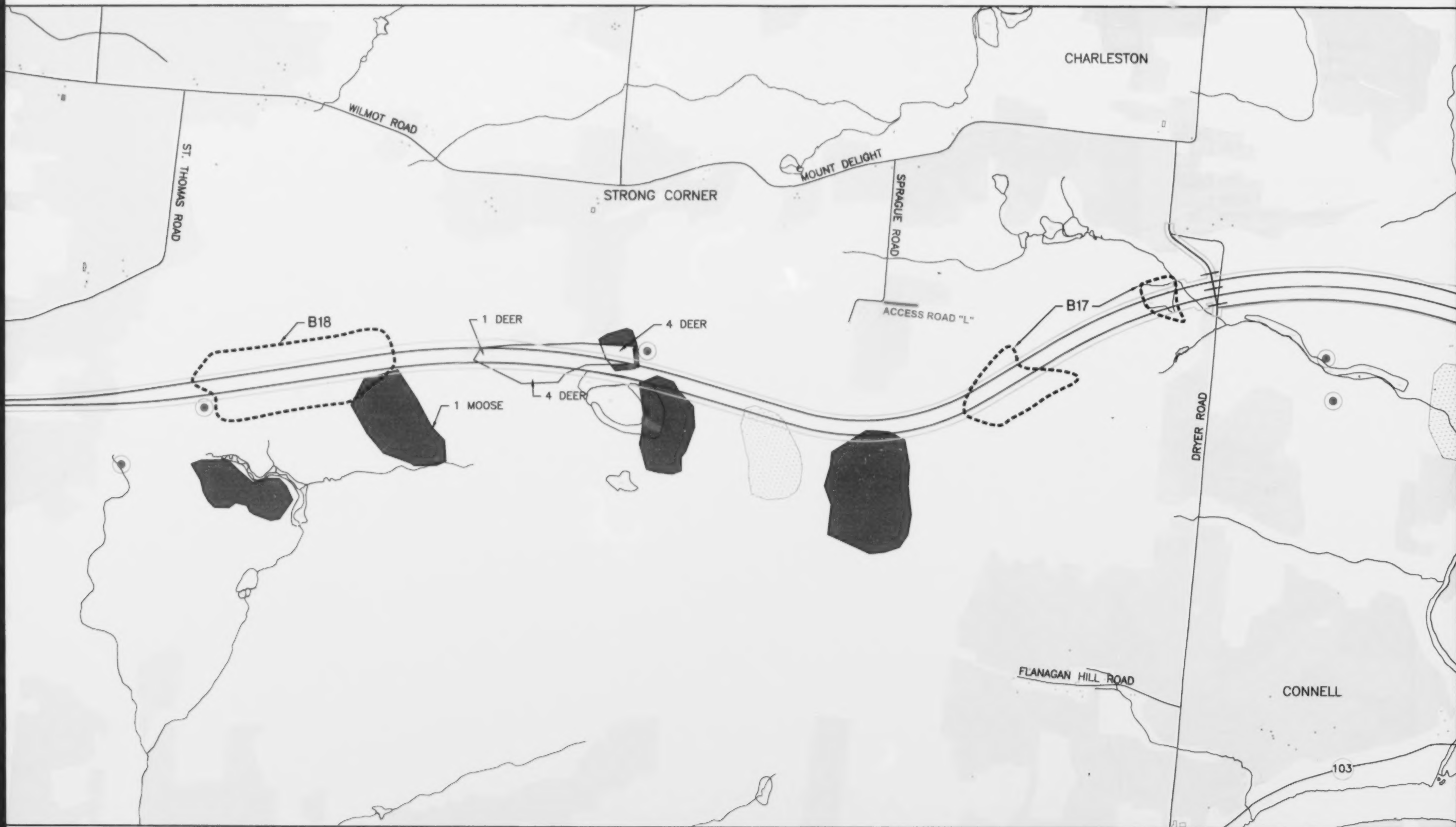


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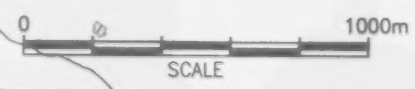
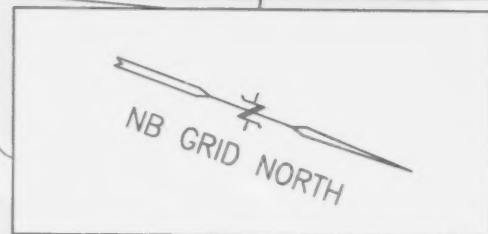


NOTE:
ALL LAND USE SHADING BASED ON FOREST INVENTORY MAPPING (1996/2000)





- LEGEND**
- 2003 ALIGNMENT CENTRELINES
 - PROPERTY ACCESS ROADS
 - LIMITS OF PROJECT FOOTPRINT
 - ▢ BUILDINGS
 - ▨ WETLAND
 - ▨ AGRICULTURAL LAND
 - ▨ DEER WINTERING AREAS
 - ⊙ DEER TRACK POINT
 - MOOSE TRACK AGGREGATION
 - ▨ MOOSE TRACK AGGREGATION-OLD
 - ⊙ MOOSE TRACK AGGREGATION POINT
 - BIRD SURVEY SITES



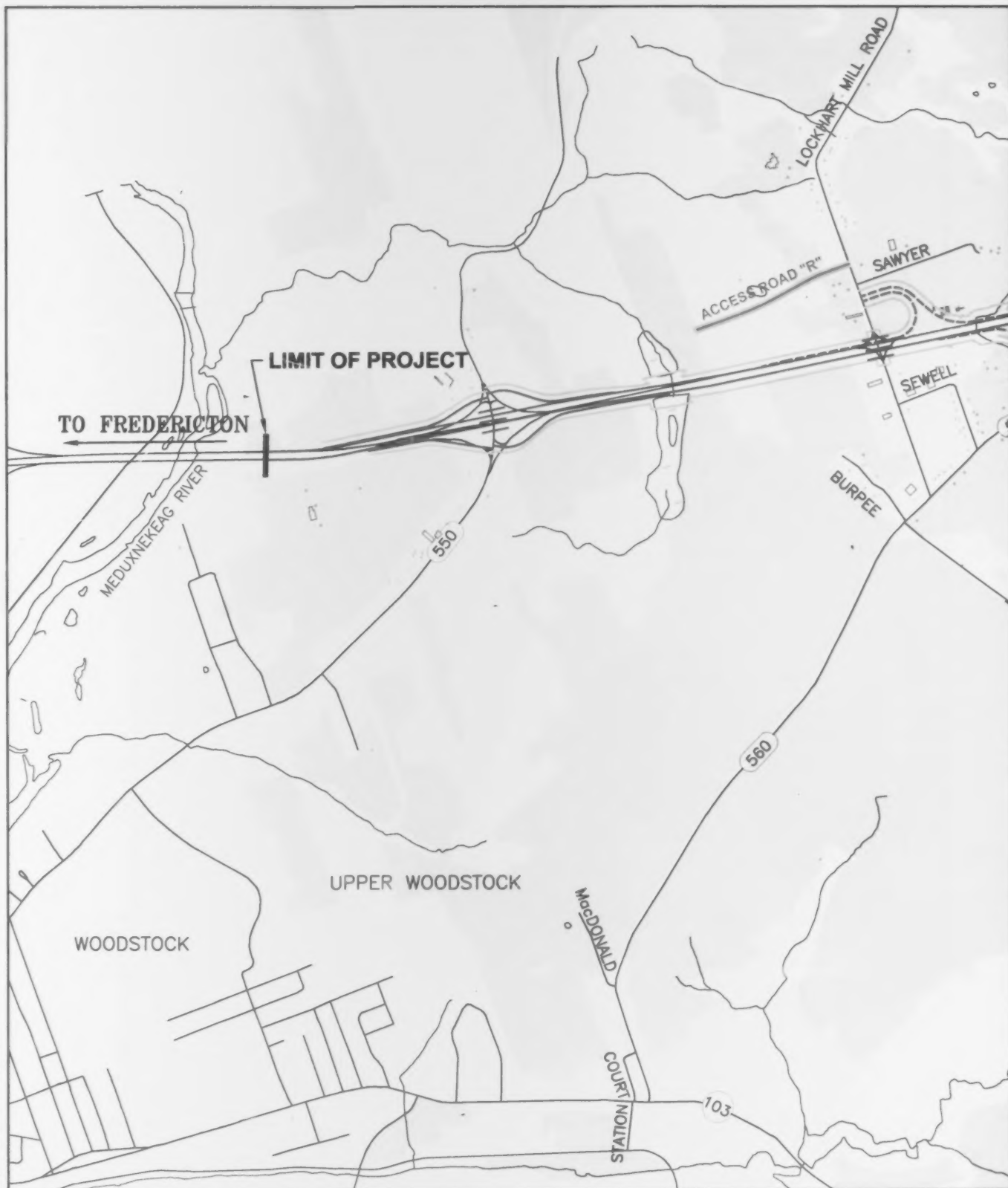
**UNGULATE AERIAL SURVEY RESULTS AND BIRD SURVEY SITES
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03
Job No.: 14677

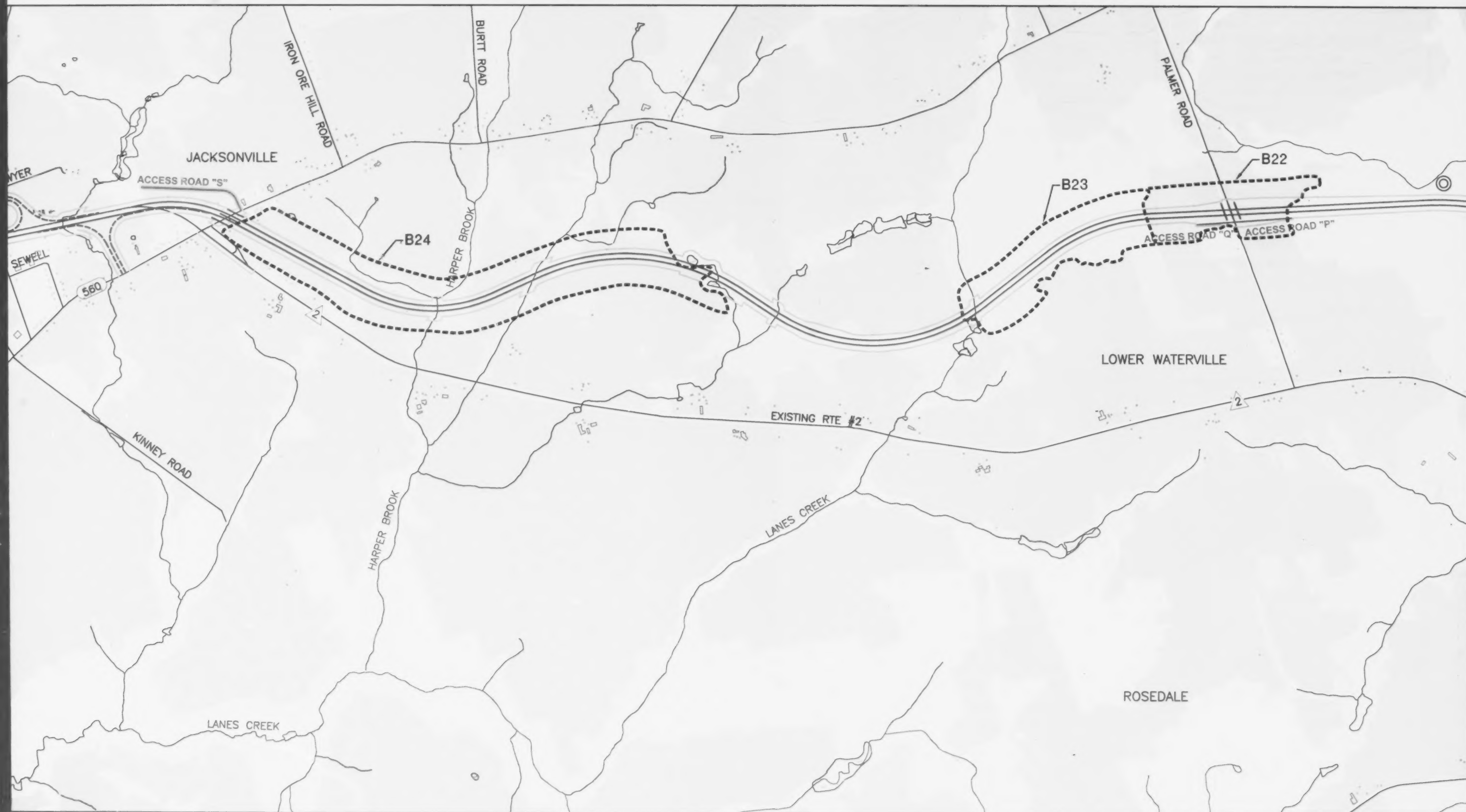
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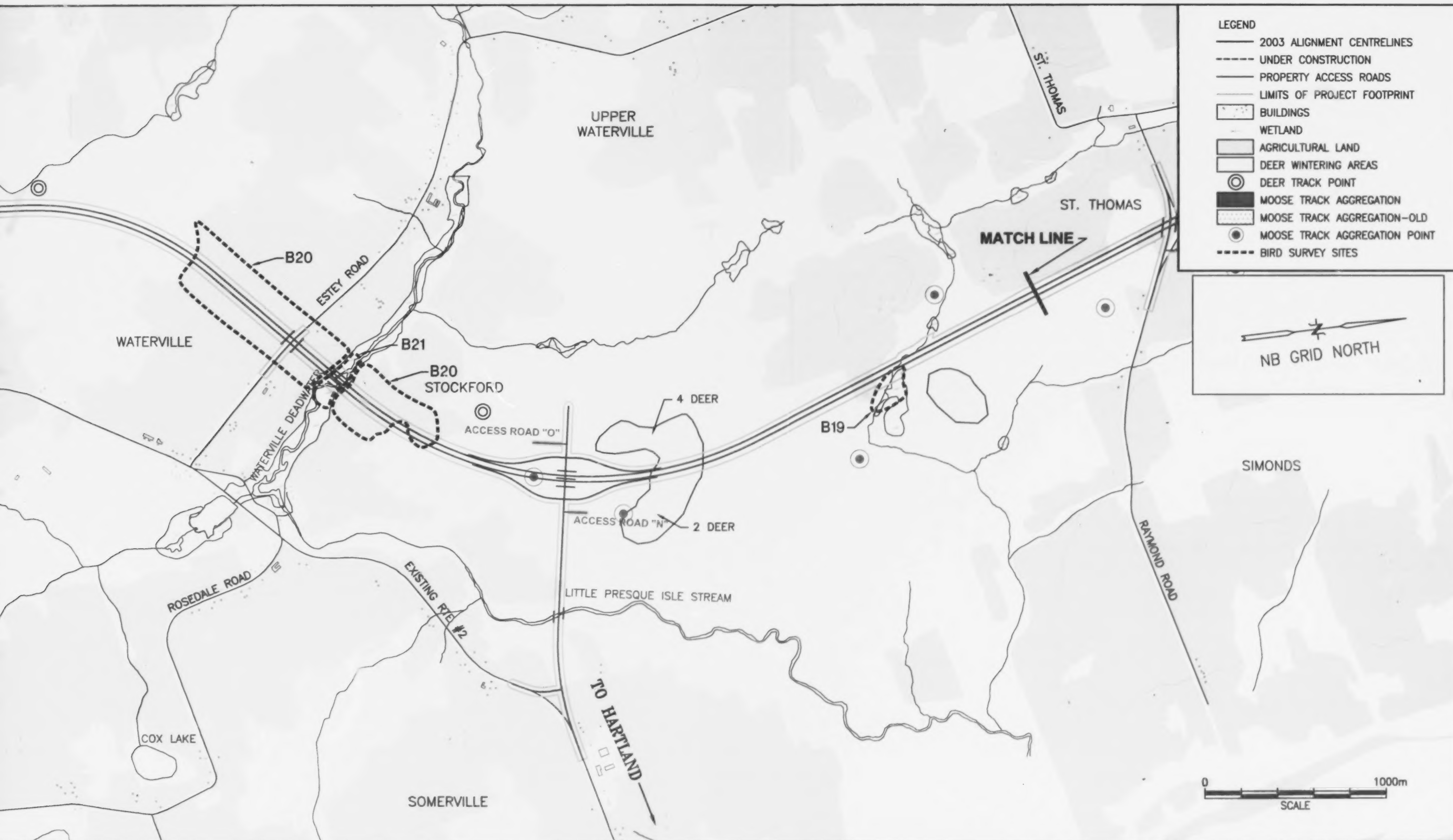
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**UNGULATE AERIAL SURVEY RESULTS AND BIRD SURVEY SITES
NEW ROUTE 2 TRANS-CANADA HIGHWAY PROJECT
PERTH-ANDOVER TO WOODSTOCK**

Date: 2004 02 03
Job No.: 14677

Scale: 1 : 20 000
Fig. No.: 5.7.1-D

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